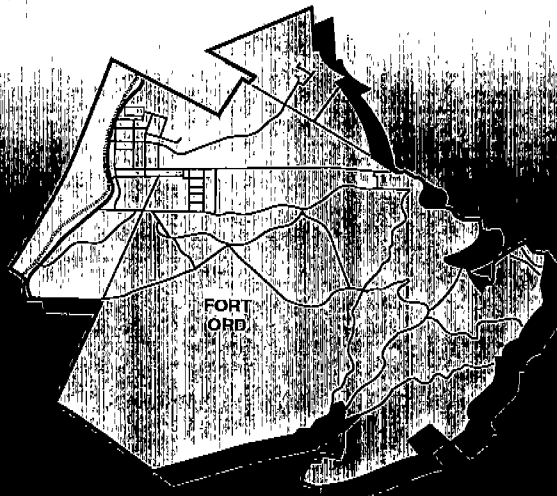


BASEWIDE REMEDIAL INVESTIGATION/ FEASIBILITY STUDY FORT ORD, CALIFORNIA



U.S. Army Corps of
Engineers



Fort Ord



Harding Lawson
Associates

Volume II -
Remedial Investigation

Chapter 3

Final Report

FINAL
October 1995

**Basewide Remedial Investigation/Feasibility Study
Fort Ord, California**

Volume II - Remedial Investigation

Site 3

Prepared for

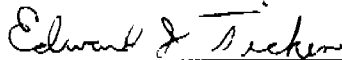
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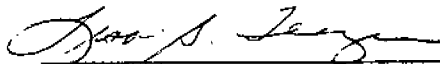
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Basewide Remedial Investigation/Feasibility Study Fort Ord, California

Volume II - Remedial Investigation

Site 3

HLA Project No. 23366 041731

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Basewide Remedial Investigation/Feasibility Study Fort Ord, California

Volume II - Remedial Investigation

Site 3

HLA Project No. 23366 041731

No agency comments were received on the Draft Final version of the Site 3 Remedial Investigation. No text changes have been made to the Draft Final version of this report.

**Basewide Remedial Investigation/Feasibility Study
Fort Ord, California**

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EXECUTIVE SUMMARY

This report presents the results of the Remedial Investigation (RI) at Site 3, the Beach Trainfire Ranges. The objectives of the RI at Site 3 were to collect sufficient data to assess: (1) the lateral and vertical extent of potential contamination, (2) the potential threat to human health and the environment from site-related chemicals, and (3) the potential remedial measures, if needed.

Background

Site 3 extends approximately 3.2 miles along the coastline of Monterey Bay at the western boundary of Fort Ord. It has been used for small arms trainfire since the 1940s. In general, trainees fired from firing lines on the eastern portion of the site toward targets spaced at varying intervals to the west. Spent ammunition accumulated on the east-facing (leeward) sides of the sand dunes that formed the "backstops" for the targets.

Site 3 is proposed for reuse as a state park consisting of hiking trails, campgrounds, and associated ancillary facilities. Boardwalks through the dunes will connect parking lots on the eastern portion of the site with the beach to the west.

Conceptual Site Model

To focus the RI data collection activities at Site 3, a conceptual site model was developed. The spent ammunition in the dune sands are the potential source of chemicals at Site 3. The possible chemical release and migration mechanisms identified included:

- Migration of spent ammunition to the surf zone through erosion
- Leaching of metals from spent ammunition to soil
- Leaching of metals through the soil to groundwater

- Migration of dissolved metals within and between aquifers
- Discharge of groundwater containing metals to Monterey Bay
- Entrainment in air of metals adsorbed to dust particles
- Bioaccumulation of chemicals by organisms, such as plants, and migration to other ecological receptors via the food web.

The data needed to investigate these potential chemical release and migration mechanisms were collected during the RI. The human receptors and exposure pathways are discussed further in the Site 3 Human Health Risk Assessment in Volume III of this report. The ecological receptors and exposure pathways are discussed further in the Ecological Risk Assessment in Volume IV of this report.

Remedial Investigation Program

The Site 3 Work Plan (*HLA, 1993f*) proposed five tasks to be conducted during the RI for Site 3: 1) source characterization, 2) soil contamination investigation, 3) air sampling investigation, 4) groundwater contamination investigation, if necessary, and 5) ecological receptor investigation, if necessary. Task 5 was conducted as part of the Basewide Ecological Risk Assessment (Volume IV of this report). Based on the evaluation of data collected during the first three tasks, the groundwater investigation (Task 4) was not considered necessary.

The three primary tasks conducted during the investigation of Site 3 are outlined below:

- Task 1: Source Characterization
 - Conducting a preliminary visual survey of two areas within the site

BIOLOGICAL INSPECTION FORM

SITE LOCATION NUMBER: 15

DATE: 11-19-91

INVESTIGATORS: C. Sorensen, K. Jolin

WEATHER CONDITIONS: Warm & windy

SITE DESCRIPTION: Paved & Fenced storage area
with ruderal species occurring along fences and
within cracks

CHARACTERISTIC PLANT SPECIES:

Plantago maritima

Bromus diandrus

ANIMALS OBSERVED:

None

RESOURCES OF CONCERN:

None

COMMENTS OR RESTRICTIONS:

None

SOIL BORING(S) / TRENCHES CLEARED:

SB 15-1



CLEARED BY: EBB/NSHA / BGM

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of metals leached using rainwater were generally higher than those leached with saltwater for both sieved and unsieved surface samples containing high concentrations of lead.

Lead concentrations in leachate samples ranged from ND to 76.6 mg/L. The highest concentrations were in the 0.33 foot sample from Test Pit E-35; 76.6 mg/L from the unsieved rainwater leach and 23 mg/L from the sieved rainwater leach. Concentrations of lead in the leachate were significantly less than 1 percent of the corresponding total concentration of lead in soil. As with the distribution of spent ammunition and concentrations of lead in soil samples, the concentrations of lead in the leachate samples decrease by orders of magnitude with depth.

Air Sampling

The results of the air quality investigation indicated that because of highly variable wind conditions, assessment of airborne contaminants originating only from Site 3 was not possible. The data collected, therefore, were used only qualitatively in the Baseline Human Health Risk Assessment. Detected metals included lead, antimony, and copper.

Extent of Contamination

The horizontal distribution of spent ammunition was most effectively evaluated using visual mapping of spent ammunition and can be applied sitewide. In areas where surface concentrations of bullets exceeded 10 percent an encrusted built layer was observed. Soil data show a correlation between high lead concentrations and high concentrations of spent ammunition (greater than 10 percent).

The vertical distribution of lead also correlates with the presence of an encrusted bullet layer, the base of which extends to approximately 2 feet bgs, extending to a maximum depth of 4 feet in the vicinity of Test Pit M-02. Only three samples below 2.0 feet contained concentrations of lead greater than maximum background. These samples were all collected within 2.5 feet of an encrusted bullet layer. Other metals (copper, zinc, and antimony) detected above their

maximum background concentrations were collocated with lead.

Risk-based target cleanup levels (TCLs) were calculated for site 3 and are presented in the Baseline Human Health Risk Assessment (Volume III of this report). A TCL for lead of 1,860 mg/kg for a child and 4,192 mg/kg for an adult were calculated based on a recreational use scenario. The TCLs will be used as remediation goals for future cleanup at site 3. Concentrations of lead greater than the TCL are generally limited to areas where surface concentrations of bullets are greater than 10 percent with the exception of Test Pit X-02 in Study Area 1.

Potential for Groundwater Contamination

As part of HLA's RI at adjacent Site 2, monitoring wells were installed to define a solvent plume. Two wells were installed in the upper portion of the 180-foot uppermost aquifer beneath Site 3, MW-02-05-180 and MW-02-10-180. MW-02-10-180 is installed within 20 feet in a crossgradient direction of a heavily bulletted dune face in Range 11 and thus, likely represents a situation where lead would be anticipated. Groundwater gradients in the area are generally flat and, given the topography of the area and the encrusted layer present on the dune face, one would expect some surface runoff and infiltration in the vicinity of MW-02-10-180. Samples collected from these wells were analyzed for priority pollutant metals; lead was not detected and other priority pollutant metals were not detected above their MCLs.

Monitoring wells MW-02-02-180 and MW-02-08-180 also installed in Site 2 are approximately 500 feet downgradient of a heavily bulletted area in Range 9. Groundwater samples collected from these wells were also analyzed for priority pollutant metals; lead was not detected and other priority pollutant metals were not detected above their MCLs, except for inconsistent detections of antimony in MW-02-08-180.

The occurrence of elevated concentrations of lead in only the shallow soils, and the groundwater data from nearby wells indicate that there is little

potential for contamination of the groundwater by lead.

Fate and Transport

Prior to collecting data for the RI, a conceptual model was developed to identify potential exposure pathways and migration mechanisms for the anticipated contaminants. Physical and chemical data were collected during the RI to evaluate the characteristics of metals that control their mobility and persistence (i.e., fate) in the environment. These data were used to assess the viable migration (i.e., transport) pathways identified in the conceptual model.

Weathering of spent ammunition has leached lead, copper, zinc, antimony and iron into the soil at Site 3. The mobility and persistence of metals in the environment are influenced by the amount, form, and oxidation state of the metal, and by the composition and physiochemical properties of the soil. Because the contaminant source is the spent ammunition, these metals appear to be present in their elemental form or as oxides. The soil properties that may affect the fate and transport of metals include: bulk density, surface area, particle size distribution, pH, oxidation/reduction potential, cation exchange capacity (CEC), salinity, and type and concentration of organic matter, clay minerals and oxides. Particle size distribution, CEC, pH, and total organic carbon (TOC) data were collected during the RI to assist in evaluation of metal retention and release processes in soil at Site 3. Lead, copper, and zinc generally behave similarly in terms of their persistence in soil. Because lead is the most toxic of these three metals, and because the highest concentrations of copper and zinc are collocated with elevated concentrations of lead at Site 3, mobility and persistence of these metals will be discussed in terms of lead.

Particle size distribution, CEC, TOC and pH are interrelated in governing contaminant persistence. Particle size distribution data indicate that soil at the site is primarily silty sand to sand with a pH ranging from 5.1 to 8.3. The CEC ranged from 2.0 to 40.3 milliequivalents per 100 grams and TOC concentrations ranged from 229 mg/kg to 4,600 mg/kg, with one sample

containing a concentration of 14,800 mg/kg. Although the soil contains very little clay, the pH, CEC, and TOC values are within a range that would favor retention of lead.

Soluble lead reacts with clays, phosphates, sulfates, carbonates, hydroxides and organic matter in soil, and greatly reduces the solubility and, hence, the mobility of lead. Soil pH greatly affects the retention of lead in soil (*Harter, 1983*). Generally, soils with a pH of 6.0 or greater will cause lead to adhere to the soil or form lead compounds. Lead also has a strong affinity for forming carbonate and oxide compounds, which also increases retention of lead, thus reducing its mobility in soil. The presence of iron in an oxidizing state could cause the formation of lead oxide compounds, which are also highly insoluble. This is evident at Site 3. The encrusted bullet layer correlates with the highest concentrations of lead and appears to be acting as an iron oxide substrate, concentrating the lead and other metals.

The primary transport mechanisms at Site 3 were identified as the leaching of lead and other metals from spent ammunition to soil and the migration of those metals in the unsaturated zone soil. Some leaching of spent ammunition to the soil has occurred at Site 3, as evidenced by high concentrations of iron, lead, copper, zinc, and antimony in soil samples collected during the RI. The site's soil properties and the vertical distribution of lead indicate that there has been very limited vertical migration. Within 2.5 feet of the encrusted bullet layer, lead concentrations decrease to near maximum background levels. The distributions of other metals (copper, zinc, and antimony) detected above maximum background were similar to that of lead and also indicate limited leaching of the metals found at the surface. These data indicate that the metals have not migrated significantly in the unsaturated zone at Site 3 and, thus, have not likely migrated to groundwater. This interpretation is supported by the available groundwater data collected from Monitoring Wells MW-02-10-180, MW-02-02-180, and MW-02-08-180, as discussed in the previous section.

1.0 BACKGROUND OF SITE 3

This section presents relevant background information, including the site history, the physical description, the proposed land reuse, and a summary of previous investigations.

1.1 History

Site 3 has been used for small arms trainfire since the 1940s. Trainees fired small-caliber hand-held weapons at targets near the leeward dune faces. According to Mr. Roy Durham, the director of Fort Ord Range Control, Ranges 1 through 8 have been used since 1975, with Range 8 receiving the heaviest and most recent use. Before 1975, all of the target ranges were used. During the training activities, cartridges were routinely collected for reuse. No routine efforts were made to collect the spent ammunition. However, in 1976 and 1977, several hundred pounds of spent ammunition were recovered at Ranges 15 and 16 by a Fort Ord contractor, with little disturbance to the dunes (EA, 1991a). This is the only known remedial activity at Site 3.

1.2 Physical Description

Site 3 extends approximately 3.2 miles (780 acres) along the coastline of Monterey Bay and forms a portion of the western boundary of Fort Ord. The site is bordered to the south by Sand City, to the north by the city of Marina, to the west by Monterey Bay, and to the east by the trainfire range access road and Highway 1 (Plate 1). Small arms firing ranges, numbered 1 through 17, are scattered along the eastern half of the site (Plate 2). No firing ranges are numbered 10 or 13. In general, trainees fired from firing lines on the eastern portion of the site toward targets spaced at varying intervals to the west. Spent bullets accumulated on the east-facing (leeward) sides of the sand dunes that formed "backstops" for the targets. A former ammunition storage area is between Ranges 3 and 4. The area west of the dunes is an undeveloped beach.

Most of the surface area of Site 3 is unpaved and vegetated, with dune sand present at the surface.

The predominant topography (i.e., numerous, intersecting rolling hills) of Site 3 reflects a morphology typical of the dune sand deposits that underlie the site. The bases of the dunes begin at an elevation of approximately 40 feet above mean sea level (MSL); the tops of the dunes extend to elevations as high as 150 feet MSL. The dunes are truncated to the west by steep cliffs formed as a result of waves and winter storms. The cliffs are up to 40 feet high above the beach.

Stilwell Hall and two sewage treatment plants are the main onsite structures. Stilwell Hall, in the central part of Site 3 and formerly used as a recreational center, was 200 to 300 feet from the shoreline when it was built in the 1940s. However, natural forces have eroded the shoreline cliffs so that Stilwell Hall is now adjacent to the shoreline. A seawall was constructed to protect the structure from the encroaching surf. The Ord Village Sewage Treatment Plant (STP) and the Main Garrison STP are contained within Site 3, but they are not considered as a part of Site 3 (Plate 2). Instead, these STPs are being investigated separately as Sites 1 and 2, respectively. Sewage is no longer treated at these plants, but instead is pumped from Site 1 and gravity fed from Site 2 to the Monterey Regional Treatment Plant (MRTP) in the city of Marina.

Seven storm drain outfalls, which collect stormwater from the Main Garrison area of Fort Ord, discharge to either the dune area or the intertidal zone of Site 3. Three of the storm drains discharge to the dunes near Ranges 8 and 11 and Site 1. The other four storm drain outfalls discharge to Monterey Bay in the surf zone along Site 3 (Plate 2). The storm drain outfalls are being investigated as part of the Basewide Surface Water Outfall Investigation (BWSWOI).

1.3 Proposed Reuse

Site 3 is proposed for reuse as a state park consisting mostly of open space (FORG, 1994).

Preliminary proposed land uses will be reviewed during the state's General Plan Process. The sandy beach area is proposed for use by the public for activities such as wading, surfing, and sunbathing. The coastal dune zone is proposed for restoration and preservation of the coastal dune habitat; public access will be limited to boardwalks or hiking trails that provide access to the beach. The disturbed dune zone will be used for restoration and preservation of coastal dune habitat and for visitor service facilities (e.g., trailheads, scenic overlooks, displays). Family campgrounds and day-use facilities are also proposed. Stilwell Hall is proposed for use as a multi-agency visitor center. The former ammunition storage area is proposed for use for equipment parking and storage. The Site 1 STP is proposed for reuse as a desalination plant. An area encompassing the Site 2 STP is proposed for development into an aquaculture and marine research center.

These proposed land uses are preliminary and will be reviewed. It is the Army's intent that site investigation and remedial activities be completed prior to implementation of land reuse plans.

1.4 Related Investigations

1.4.1 Investigation of Sites 2 and 12

Site 2 is the Main Garrison STP. Site 12, immediately east of Site 3, encompasses the Lower Meadow/DOL Automotive Yard/Cannibalization Yard and a portion of the Southern Pacific Railroad Spur. As part of HLA's Remedial Investigation (RI) at Sites 2 and 12, monitoring wells were installed to define a solvent plume that extends from Site 12, east of Highway 1, towards Monterey Bay. Two monitoring wells, MW-02-05-180 and MW-02-10-180 (Plate 2), were installed within the upper portion of the 180-foot aquifer at Site 3. The 180-foot aquifer is the uppermost aquifer beneath the site and is described further in Section 2.5. Well MW-02-05-180 was installed near Range 9. Well MW-02-10-180 was installed within 20 feet in a crossgradient direction of a heavily bulleted dune face in Range 11. Subsequent to installation, these wells were

sampled for priority pollutant metals and volatile organic compounds (VOCs).

Groundwater analytical results were compared to federal and state Maximum Contamination Levels (MCLs). The lowest of the two MCLs was used for comparison. Current federal and state MCLs are presented in Table F1 (Appendix F). Lead was not detected and other priority pollutant metals were not detected above MCLs in the groundwater sample from Well MW-02-05-180. Trichloroethene (TCE) and 1,2-dichloroethene (1,2-DCE) were the only VOCs detected above their MCLs. Analytical results for the groundwater sample from MW-02-10-180 indicated that lead was not detected and other priority pollutant metals were not detected above their MCLs. VOCs detected included 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), tetrachloroethene (PCE), and TCE, but none of these exceeded its MCL.

Monitoring Wells MW-02-02-180 and MW-02-08-180 also located in Site 2; both wells are approximately 500 feet downgradient of a heavily bulleted area in Range 9 (Plate 2). Groundwater samples collected from these wells were also analyzed for priority pollutant metals; lead was not detected and other priority pollutant metals were not detected above their MCLs, except for inconsistent detections of antimony in MW-02-08-180.

Additional information on the construction, sampling, and analytical results for these wells is provided in Volume II - Sites 2 and 12 Text, Tables, and Plates of this report.

1.4.2 Investigation of Site 1

As part of HLA's investigation of Site 1 (Ord Village STP), three monitoring wells were installed in the upper 180-foot aquifer (Plate 2). Subsequent to installation, the wells were sampled during three separate events and analyzed for total petroleum hydrocarbons (TPH) as gasoline and diesel, VOCs, semivolatile organic compounds (SOCs), priority pollutant metals, pesticides and polychlorinated biphenyls (PCBs), oil and grease, and fecal coliform. Analytical results indicate that thallium,

antimony, and cadmium were detected above their MCLs. Lead was not detected in any of the groundwater samples. Methylene chloride was the only other analyte detected above its MCL.

Additional information regarding the sampling and analytical program for Site 1 is provided in Volume I - Site 1 Summary of this report.

1.4.3 Basewide Surface Water Outfall Investigation (BWSWOI)

The purpose of the BWSWOI was to assess whether there has been transport of contaminants to the surface water outfalls via the surface water drainage or storm drain systems. The subsurface storm drain system discharges to either on-land surface water outfalls or ocean outfalls in the surf zone. The surface water drainage system comprises aboveground natural or manmade drainages that discharge to or receive discharge from the subsurface storm drain system. The BWSWOI included sampling of soil from borings completed at the surface water outfalls and of sediment from within the storm drain system outfall pipes, manholes, or catch basins. A video reconnaissance of the storm drain system from the ocean outfalls to beneath Highway 101 was performed to locate areas where sediment had collected in the storm drain pipelines between the manholes. No catch basins (i.e., structures to facilitate surface water runoff into the storm drain pipelines) were identified within the Site 3 boundaries. Therefore, the data for sediment samples collected from these pipelines are not relevant to Site 3.

Within the boundaries of Site 3 (Plate 2), the soil at two surface water outfalls (sampling locations OF-05 and OF-15) was sampled. The analytical results for the BWSWOI are presented and discussed in Volume II - Remedial Investigation, General, Basewide Programs of this report. Although some pesticides, VOCs, metals, and an unknown hydrocarbon were detected in the OF-05 sample, the human health screening risk evaluation (SRE) conducted using these data indicated no human health risks and no further action (NOFA) was proposed for OF-05 under the BWSWOI. Soil samples obtained from soil borings at sampling location OF-15 contained

unknown hydrocarbons at 2.25 feet below ground surface (bgs) and the outfall location requires further characterization under the ongoing BWSWOI. The potential impacts to groundwater from the hydrocarbons in the soil at the outfall will be assessed when the additional characterization is completed. A more detailed discussion of the BWSWOI is included in the basewide programs section of Volume II of this report.

1.4.4 Baseline Ecological Risk Assessment

Plant and associated soil samples were collected during the Baseline Ecological Risk Assessment to evaluate the effects of lead in soil on native vegetation. Four composite soil samples were collected in each study area and five composite soil samples were collected in the Control Area.

To accommodate the collection of samples that represented a wide area, sampling was conducted using four transects in Study Area 1 and Study Area 2, and five transects in the Control Area. In each area, one composite soil sample was composited using soil collected at the surface along each transect. Each sample was analyzed for priority pollutant metals. All of the priority pollutant metals concentrations detected were within the range of concentrations detected at the site with the exception of Sample SS-03.1.2 collected in a heavily bulleted area. This sample contained lead at a concentration of 47,500 mg/kg. This only slightly exceeded the maximum concentration of lead (46,300 mg/kg) detected during Site 3 RI soil sampling activities (see Section 4.2.3).

A detailed discussion of soil and biota samples collected at Site 3 as part of the Baseline Ecological Risk Assessment is provided in Volume IV of this report.

2.0 PHYSICAL CHARACTERISTICS

This section describes the physical characteristics of the site and vicinity. These characteristics include climate, biology, geology, surface water hydrology, and hydrogeology. Each of these characteristics is discussed in the following sections.

2.1 Climate

The Pacific Ocean is the principal influence on the climate at Fort Ord. Daily ambient air temperatures typically range from approximately 40 to above 70 degrees Fahrenheit (°F), but temperatures slightly above 100°F occur occasionally. Thick fog is common in the morning throughout the year. Winds are predominantly from the west during the spring and summer months, but are variable during the fall and winter. The average annual rainfall of 14 inches occurs almost entirely between November and April.

2.2 Biology

The ecological setting at Fort Ord was described by HLA as part of the *Draft Basewide Biological Inventory*, dated December 9, 1992, Ecological Risk Assessment (Volume IV of this report), and by the U.S. Army Corps of Engineers (COE, 1992a). Additional information on the plant communities at Fort Ord can be found in Hickman (1993), Munz (1959), Küchler (1977), and Schoenherr (1992). The distributions of biological communities within Site 3 are shown on Plates 3, 4, and 5 and summarized below.

Biological communities at Site 3 include active dune, beach, vegetatively stabilized dune, central coastal scrub, northern foredune grassland, landscaped, and upland ruderal. Active dune and beach communities are characterized by physical factors (e.g., active sand deposition), with little or no vegetation. The remaining five communities occur in a narrow band between the area of active dune and Highway 1, and are described as follows:

- Vegetatively stabilized dunes: Occupies the greatest area within Site 3. Characteristic plants in the vegetatively stabilized dune community include hottentot fig (*Carpobrotus edulis*), sea fig (*Carpobrotus chilensis*), pink sand verbena (*Abronia umbellata* ssp. *umbellata*), European beachgrass (*Ammophila arenaria*), seaside daisy (*Erigeron glaucus*), and California poppy (*Eschscholzia californica*). Hottentot fig and seafig are more commonly known as ice plant.
- Central coastal scrub community: Characterized by a dense cover of shrubs, subshrubs, and herbs that generally grow to a maximum height of about 3 feet. This community occurs primarily in leeward areas within the dune complex. Characteristic plants in the central coastal scrub community include coyote brush (*Baccharis pilularis*), coastal sagewort (*Artemisia pycnocephala*), mock heather (*Ericameria ericoides*), and California broom (*Lotus scoparius*).
- Northern foredune grassland community: Dominated by stands of low-growing sand-dune bluegrass (*Poa douglasii*). This grassland community occurs in dune swales, typically as isolated patches smaller than 30 square feet. In addition to this dominant species, hottentot fig and several low-growing shrubs may occur in the northern foredune grassland community. Northern foredune grassland is considered sensitive by resource agencies.
- Landscaped communities: Characterized by tall, cultivated trees and shrubs intentionally introduced and maintained. Commonly planted trees and shrubs in this community include Australian tea tree (*Leptospermum laevigatum*), blue gum (*Eucalyptus globulus*), Monterey cypress (*Cupressus macrocarpa*), and golden wattle (*Acacia longifolia*). Annual grasses such as rattail fescue (*Vulpia myuros* var. *m.*) and red brome (*Bromus madritensis*

ssp. *rubens*) occur in scattered openings within the landscaped communities.

- **Upland ruderal communities:** These areas support primarily non-native weedy plants adapted to disturbed conditions. Characteristic non-native taxa in the upland ruderal community include hottentot fig, sea fig, ripgut grass (*Bromus diandrus*), red-stemmed filaree (*Erodium cicutarium*), weedy cudweed (*Gnaphalium luteo-album*), and kikuyu grass (*Pennisetum clandestinum*). Upland ruderal communities also support a few native taxa such as Monterey spineflower (*Chorizanthe pungens* var. *pungens*), buckwheat (*Eriogonum* spp.), and cardionema (*Cardionema ramosissimum*) as minor components of the community.

Animals commonly observed in all communities present at Site 3 include California ground squirrel (*Spermophilus beecheyi*), red fox (*Vulpes vulpes*), and loggerhead shrike (*Lanius ludovicianus*). Central coastal scrub, landscaped, and upland ruderal communities provide cover and/or foraging habitat for additional species including yellow-rumped warbler (*Dendroica coronata*), Anna's hummingbird (*Calypte anna*), and house finch (*Capodacus mexicanus*).

Special-status taxa observed or reported near Site 3 include Smith's blue butterfly (*Euphilotes enoptes smithi*), California black legless lizard (*Anniella pulchra nigra*), western snowy plover (*Charadrius alexandrinus nivosus*), loggerhead shrike, merlin (*Falco columbarius*), sand gilia (*Gilia tenuiflora* ssp. *arenaria*), Kellogg's horkelia (*Horkelia cuneata* ssp. *sericea*), coast wallflower (*Erysimum ammphilum*), Yadon's piperia (*Piperia yadonii*), sandmat manzanita (*Arctostaphylos pumila*), Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*), Monterey spineflower, Robust spineflower (*Chorizanthe robusta* var. *robusta*), Monterey Indian paintbrush (*Castilleja latifolia*), Menzies' wallflower (*Erysimum menziesii* ssp. *menziesii*), and Seaside bird's-beak (*Cordylanthus rigidus* var. *littoralis*). The status of these taxa is presented in Table 1 in order of decreasing sensitivity.

2.3

Geology

The uppermost deposits at Site 3 include beach sand and recent and older dune sand. Beach sand is restricted to the coastline and consists of unconsolidated, well-sorted, fine- to coarse-grained sand composed largely of quartz and feldspar. Localized deposits consisting of sand composed largely of heavy minerals and sand mixed with rounded gravels occur sporadically as a result of segregation by wave action. Steep bluffs border much of the landward portion of the beach, and at least a portion of the beach sand is derived from erosion of the dunes forming the bluffs.

The recent dunes are typical, parabola-shaped structures oriented with the long axis perpendicular to the shoreline, coinciding with the dominant westerly onshore wind. The dunes are composed of loose, well-sorted, fine-to-medium grained quartzose sand. The recent deposits are up to 100 feet thick and, for the most part, are heavily vegetated and, therefore, stabilized. Historical aerial photographs from 1941 through 1992 confirm that the dunes have been stable since at least the time that the area was first used for trainfire ranges. Cooper (1967) suggests that the dunes have been stable since the slowing of the rise in sea level after the last ice age.

Waves and winter storms are eroding the dunes along the shoreline, forming steep cliffs up to heights of about 40 feet. The dunes are also truncated along their landward sides by the firing ranges. The only active deposition on the dunes is in the blowouts that result from wind erosion in weak areas along the shoreline side of the dunes. The blowouts appear as spoon-shaped, sandy areas devoid of vegetation that form narrow roughly east-west troughs that slope toward the shoreline (see Plate 8). Sand from the troughs is blown to the top of the dunes by the wind and accumulates as a leeward-pointing tongue.

Recent dune deposits overlie Pleistocene- to Holocene-age dune sand deposits up to 250 feet thick. This older dune sand is predominantly fine- to medium-grained, with an abundance of quartz and feldspar. The older deposits are

slightly more consolidated than the recent dune sand, and form resistant ledges in the erosional zone of the blowout areas. The former ground surface of these older deposits appear as paleosols along the cliff face of the dunes.

2.4 Surface Water Hydrology

Surface water runoff is minimal at Site 3 because of the high rate of surface water infiltration into the permeable dune sand. Consequently, well-developed, natural drainage channels are absent throughout the site. Typical of dune topography, closed drainage depressions resulting from coalescing dune troughs are common throughout the site.

2.5 Hydrogeology

The hydrogeology of Fort Ord was investigated as part of the Basewide Hydrogeologic Characterization and is described in greater detail in Volume II of this report. Information collected for the basewide study pertinent to Site 3 follows.

Site 3 overlies the western portions of both the Salinas and the Seaside basins, the two main hydrogeologic structures underlying Fort Ord. Five hydrostratigraphic units have been identified in the Salinas Basin: A-aquifer, Salinas Valley Aquiclude (SVA), 180-foot aquifer, 400-foot aquifer, and the 900-foot aquifer. In the Salinas Basin, the SVA separates the A-aquifer from the underlying 180-foot aquifer over most of Fort Ord but is absent beneath Site 3. Therefore, at Site 3, the merged A- and 180-foot aquifers of the Salinas Basin are treated as one unit, and is referred to as the upper 180-foot aquifer. A silty and clayey sand aquitard separates the upper 180-foot aquifer from the lower 180-foot aquifer. The Seaside Basin underlies the southern portion of Site 3. The aquifers in the Seaside Basin are referred to by their geologic formation names rather than their average depth to groundwater. Progressing downward, these are the Aromas Formation, the Paso Robles Formation, and the Santa Margarita Formation. Together, the recent and older dune sands comprise the upper portion of the unconfined 180-foot aquifer in the Salinas Basin and the uppermost aquifer in the Seaside Basin.

Data on water levels obtained from monitoring wells installed as part of the investigation of Sites 2 and 12 indicate that the depth to groundwater near Site 3 ranges from approximately 20 to over 100 feet bgs. At Range 11, the groundwater level in Monitoring Well MW-02-10-180 (Plate 2) is approximately 40 feet bgs, given the topography and elevation variations at Site 3, groundwater is shallowest in this area. Based on data obtained from the Sites 2 and 12 investigation, the gradient in this area appears to be relatively flat. Potentiometric maps suggest that horizontal flow across the site is predominantly to the west/southwest at Sites 1 and 2 and in the southern and north-central portions of Site 3 (Plate 2).

Tidal studies conducted as part of the investigations of Sites 1 and 2 indicate that groundwater flow beneath these two sites is influenced by tides, resulting in small (± 0.5 foot maximum) diurnal changes in groundwater levels. Seawater intrusion is documented to occur beneath the site in the upper 180-foot aquifer near the beach, the lower portion of the 180-foot aquifer, and the 400-foot aquifer. In the Seaside Basin, seawater intrusion has been documented in the uppermost aquifer (Aromas Formation) only.

3.0 CONCEPTUAL SITE MODEL

A conceptual site model was developed for Site 3 and presented in the *Draft Final Work Plan, Site 3* (Site 3 Work Plan) (HLA, 1993f). The conceptual site model was used to identify the data needed to specifically evaluate whether current or future complete exposure pathways are expected at Site 3, and, if the pathways are complete, to assess potential human health and ecological risks associated with site-related chemicals. Plate 6 illustrates the possible chemical migration pathways that were considered at Site 3.

The Environmental Protection Agency (EPA, 1989b) describes exposure pathways in terms of four components:

- A source and mechanism of chemical release
 - A retention or transport medium (or retention media in cases involving media transfer of chemicals)
 - A point of potential contact (referred to as the exposure point) by a human or ecological receptor with the contaminated medium
 - An exposure route (e.g., ingestion) at the exposure point.
- Migration of spent ammunition to the surf zone through erosion
 - Leaching of metals from spent ammunition to soil
 - Leaching of metals through the soil to groundwater
 - Migration of dissolved metals within and between aquifers
 - Discharge of groundwater containing metals to Monterey Bay
 - Entrainment in air of metals adsorbed to dust particles
 - Bioaccumulation of chemicals by organisms, such as plants, and migration to other ecological receptors via the food web.

All four of these components must be present for a potential exposure pathway to be considered complete.

3.1 Chemical Source

The spent ammunition in the dune sands is the potential source of chemicals at Site 3. The likely chemicals are lead, copper, and other priority pollutant metals.

3.2 Possible Chemical Release and Migration Mechanisms

The possible chemical release and migration mechanisms identified at Site 3 are listed below (Plate 6):

The data needed to investigate these potential chemical release and migration mechanisms were collected during the RI. As mentioned in Section 2.4, a significant volume of stormwater runoff is not expected at the site because of the high porosity of the dune sands; therefore, this migration pathway was not addressed further in this RI. Potentially contaminated surface water runoff discharged from the storm drain or stormwater beach outfalls to surface water or soil at Site 3 was evaluated separately in the BWSWOI and is described further in the basewide programs section of Volume II of this report.

3.3 Possible Receptors and Complete Exposure Pathways

Possible human and ecological receptors were identified during the RI. The data required to evaluate whether potential exposure pathways are complete for each of the receptors were also collected during the RI and Ecological Risk Assessment. Human receptors and exposure pathways are discussed further in the Site 3

Human Health Risk Assessment in Volume III of this report. Ecological receptors and exposure pathways are discussed further in the Ecological Risk Assessment in Volume IV of this report.

4.0 REMEDIAL INVESTIGATION PROGRAM

This section describes the scope of work and discusses the results of the RI at Site 3. The goal of the RI at Site 3 was to collect sufficient data to assess 1) the lateral and vertical extent of potential contamination, 2) the potential threat to human health and the environment from site-related chemicals, and 3) the potential remedial measures, if needed. A phased field program was proposed in the agency-approved Site 3 Work Plan (HLA, 1993f); sampling was to be conducted based on the findings from previous phases. Based on the site background and conceptual site model, the following five tasks were proposed in the Site 3 Work Plan and are outlined on Plate 7:

- Source characterization (Task 1 on Plate 7)
- Soil contamination investigation (Task 2)
- Air sampling investigation (Task 3)
- Groundwater contamination investigation, if necessary (Task 4)
- Ecological receptor investigation, if necessary (Task 5).

The ecological receptor investigation (Task 5) was included in the scope of work for the Basewide Ecological Risk Assessment (Volume IV of this report) and was not conducted as part of the Site 3 RI. Deviations from the Site 3 Work Plan are noted in the appropriate sections herein. Because of its large size (approximately 780 acres), three areas of Site 3 were selected to represent site conditions. Ranges 11 and 12 (Study Area 1) were selected to represent the older ranges that have not been used since 1975. Ranges 5 through 8 (Study Area 2) were selected to represent the ranges that have received the most recent heavy use. An area between Ranges 8 and 9 was selected as a Control Area because it reportedly was never used as a firing range. The study areas are shown on Plate 2. The three study areas (Study Areas 1 and 2 and the Control Area) extend from the east side of the ranges (just west of Highway 1) to the shoreline. Each study area contains about 70 acres.

The three primary tasks conducted during this investigation are outlined below:

- Task 1: Source Characterization (Section 4.1)
 - Conducting a preliminary visual survey of two areas within the site (Section 4.1.1)
 - Evaluating the distribution of spent ammunition (Section 4.1.2)
 - Detailed visual mapping and confirmation sampling in three study areas
 - Geophysical survey concurrent with the visual mapping
 - Sitewide reconnaissance visual mapping, including all blowouts
 - Detailed mapping of five blowouts
 - Visual mapping in five surf zone test pits.
 - Evaluating the chemical characteristics of the spent ammunition (Section 4.1.3).
- Task 2: Soil Investigation (Section 4.2)
 - Excavating 23 test pits in the study areas and collecting 3 soil samples from each test pit for metals analysis (69 samples)
 - Collecting 3 additional samples in each of 5 of the test pits for leachate analysis (15 samples)
 - Collecting one separate surface sample in each test pit for particle size analysis (23 samples).
- Task 3: Air Quality Investigation (Section 4.3), which included collecting and analyzing air samples from one study area.

The need for a groundwater investigation was evaluated on the basis of results of the investigation (Section 5.4).

The specific field investigation activities and their goals or objectives are summarized in Table 2. Before conducting intrusive field activities, proposed sampling locations were cleared for sensitive biological species, underground utilities, and unexploded ordnance.

4.1 Source Characterization

4.1.1 Preliminary Visual Survey

On October 13, 1992, Harding Lawson Associates (HLA) conducted a preliminary visual survey to identify the types and general distribution of spent ammunition at Site 3. The survey included traversing two areas of the site, one area from Range 11 to Range 17 and one at Range 8. Several shallow (less than 3 feet deep) test pits were excavated in both areas, for visual observations only.

The majority of spent ammunition observed in these two areas at Site 3 consisted of spent bullets (i.e., combined slugs and metal jackets) and metal fragments. From visual observations, the spent ammunition appeared to consist primarily of copper and lead. Many of the metal fragments were covered with coatings or encrustations that appeared to be either copper oxide or iron oxide. Many of the lead slugs appeared to be coated with a white lead oxide. From these observations, lead and copper were considered to be the primary potential site-related chemicals; other priority pollutant metals were potentially present but at lesser concentrations.

Plates 8 and 9 show the estimated distribution of spent ammunition based on the preliminary survey; similar distribution patterns were observed in both surveyed areas. In the areas surveyed, the concentration of spent ammunition was greatest in an approximately 10- to 30-foot-high band along the sand dunes immediately behind the target areas. In this band, about 10 percent or more of the ground surface was covered with spent ammunition; the shallow test pit excavations in such areas indicated the presence of two distinct zones of

spent ammunition. The first zone was a surface layer about 3 inches thick, within which concentrations of spent ammunition consisting of slugs, bullet fragments, and jackets were greater than 10 percent. Beneath this surface zone was an underlying zone containing highly oxidized, sand-encrusted bullets (i.e., sand and spent ammunition fragments, moderately cemented by oxidized metal); this zone generally extended to about 1 to 2 feet bgs. Spent ammunition was generally absent below 1 to 2 feet. Representative photographs illustrating the vertical distribution of spent ammunition at Site 3 are presented on Plate 10.

Above the highly concentrated band and generally extending to about the top of the dune, the surface concentration of spent ammunition decreased to less than 10 percent with little, if any, ammunition below the ground surface. From the top of the dunes to the shoreline, the surface concentration of the spent ammunition was less than 1 percent with none observed below the ground surface. Spent ammunition also occurred at greater than 10 percent (by area) along the eroding surface of blowouts, but was scarce to nonexistent on the surface of their depositional tongues. Spent ammunition was also scarce to nonexistent in areas of the dunes between the ranges.

4.1.2 Distribution of Spent Ammunition

4.1.2.1 Field Investigation

Between October and December 1993, HLA conducted visual mapping, collected confirmation samples, and used surface geophysical methods to investigate the distribution of the spent ammunition within the site.

Visual Mapping and Confirmation Sampling

The visual mapping survey consisted of setting up a rectangular grid on 50-foot centers, traversing each study area along the lines of the grid, and estimating the occurrence and the percentage of surface area covered by spent ammunition at the grid nodes. The percentage of surface area covered by spent ammunition in the

control area was assessed at grid nodes on 300-foot centers. To confirm the visual estimates, the surface area coverage was also quantitatively assessed by removing the top 1 inch of soil and spent ammunition in a 9-square-foot area at the nodes of a rectangular grid on 300-foot grid centers; the nodes coincided with those on the grid utilized for the visual survey. Eighty-three of these areas were sampled (Table 3). For each sample, the total volume of collected soil was weighed then sieved using a No. 8 sieve. The spent ammunition fraction of the total sample was then weighed, and a quantitative measure of the amount of spent ammunition was calculated as follows:

$$\text{Weight Percent of Spent Ammunition} = \frac{\text{Bullet Weight}}{\text{Total Weight}} \times 100$$

This quantitative assessment of the concentration of spent ammunition is referred to throughout the remainder of this document as "confirmation sampling." Locations where confirmation sampling was conducted are referred to as "confirmation sampling points."

Geophysical Survey

A geophysical survey was conducted concurrently with the visual mapping to provide additional information on the surface and subsurface extent and concentration of spent ammunition, especially in areas of surface vegetation (primarily ice plant) where visual estimates could not be made. To evaluate which geophysical instrument(s) provided the most effective and useful data, four nonintrusive, surface-sweeping geophysical techniques were tested in the Control Area. The geophysical instruments tested included the Models EM31-D, EM38, and EM61 electromagnetic meters manufactured by Geonics Limited (Geonics) and the Model 5500/D metal detector from Whites Instruments. All of these instruments have the ability to detect near-surface ferrous and nonferrous metals. The instruments differ in their sensitivity to the local mass of metal (bullet concentration) and the depth of burial. Measurements from these instruments are also

affected to some extent by changes in soil type and soil moisture.

The initial tests indicated that the EM38 and Model 5500/D metal detector were the most effective of the four instruments for detecting shallow concentrations of spent ammunition at Site 3. After testing and development of data measurement procedures, a geophysical survey of the Control Area, Area 1, and Area 2 was performed in both vegetated and nonvegetated areas along the same grid used during the visual survey. Following preliminary interpretation of the geophysical data, several shallow (less than 3 feet deep) pits were excavated for visual estimation of the concentration of spent ammunition to help understand, calibrate, and validate the findings of the geophysical survey.

Sitewide Visual Survey

In December 1993, HLA conducted a visual survey similar to the preliminary visual survey described in Section 4.1.1. The survey consisted of visual reconnaissance mapping of the distribution of spent ammunition in the accessible areas of Site 3 that had not previously been mapped; the survey included the blowout areas near the beach but excluded the three study areas. Six HLA geologists traversed the site from south to north and recorded visual observations of spent ammunition distribution on maps of the site.

Mapping of Representative Blowouts

Results of the preliminary visual survey suggested that bullets may be migrating from the dunes to the beach and possibly to the intertidal zone through erosion. To evaluate this potential transport pathway, five blowouts along the beach were investigated (Plate 11). Each blowout was mapped by visually estimating the surface area covered by spent ammunition at the top (easternmost), middle, and bottom (westernmost) third of the blowout. To confirm the visual estimates, confirmation sampling was conducted at two 9-square-foot areas in each third and at one 9-square-foot area at the base of the five blowouts (i.e., 35 confirmation sampling locations). In addition, one test pit up to 3 feet deep was excavated at the base of each blowout

to visually assess the potential for accumulation of spent ammunition.

Surf Zone Test Pits

The distribution of spent ammunition in the surf zone was estimated using visual observations and by excavating five shallow, hand-dug test pits to an approximate depth of 3 feet. The surf zone test pit locations are shown on Plate 11. Confirmation sampling was not conducted in the surf zone test pits.

All activities were performed in accordance with the Site 3 Work Plan, with the following exceptions:

- Only five blowouts were investigated because the visual reconnaissance mapping indicated the presence of numerous blowouts. The five chosen for detailed mapping were the largest blowouts with the most variable distribution of spent ammunition.
- Due to the accelerated field schedule for mapping the study areas, the geophysical survey was completed prior to comparison of the geophysical data and the visual estimates obtained from the test pits and confirmation sampling locations.

4.1.2.2 Results and Discussion

Plate 11 presents the estimated surface distribution of spent ammunition across the site, based on the visual reconnaissance mapping, test pits and confirmation sampling at the five selected blowouts, and surf zone test pits. Plates 12 and 13 show the detailed surface distribution of spent ammunition in each study area. The results of the visual reconnaissance mapping, the detailed mapping effort within the study areas, the geophysical investigation, the blowout mapping, and the surf zone test pits follow:

- The distribution patterns observed during the reconnaissance visual mapping were similar to those observed during the preliminary survey (Plate 11). The concentrations of spent ammunition were generally highest (greater than 10 percent) in a band along the

eastern slopes of the sand dunes, immediately behind the target areas. Between the firing lines and the targets and outside the heavily concentrated zone behind the targets and extending to the tops of the dunes, concentrations of spent ammunition decreased to 1 to 10 percent. In areas between the ranges and from the tops of the dunes to the shoreline, concentrations of spent ammunition decreased to less than 1 percent.

- The weight percents (of spent ammunition) obtained from the confirmation sampling locations correlated well with the visual estimates (Table 3)
- After the geophysical survey in the three study areas, the Geonics Model EM38 data were evaluated to assess correlation with bullet concentrations estimated by visual methods. The data did not correlate well with the visual estimates; the EM38 measurements appear to have been adversely affected by soil moisture variations across the site. Therefore, the EM38 data could not be used to map the concentrations of spent ammunition in the upper 1 to 3 feet.
- The Whites Model 5500/D metal detector measures the relative response from surface and buried metal (up to a depth of 6 inches) only for a localized area immediately beneath the instrument (i.e., it cannot provide information about concentrations of bullets in adjacent areas). The technique was successful in both vegetated and unvegetated areas. Data from visual observations indicated that the interpretation of the 5500/D data is limited; therefore, the 5500/D data were used only to guide the assessment of whether bullet concentrations in the upper 6 inches were less than or more than approximately 5 percent by weight.
- The detailed mapping of Study Areas 1 and 2 (Plates 12 and 13) confirmed the results of the visual reconnaissance mapping. The highest surface concentrations of spent ammunition were in bands along contours of relatively equal elevation on the dunes directly behind the target areas, indicating

that the spent ammunition passed through or by the targets and collected on the eastern sides of the dune faces. Moderate concentrations of spent ammunition (1 to 10 percent) surround the high concentration areas. Low concentrations (less than 1 percent) of spent ammunition are found between the firing lines and the targets and adjacent the moderate zones.

- The detailed mapping of the Control Area indicated that spent ammunition was absent from the surface, with the exception of a few isolated areas where bullets were encountered at a surface concentration of less than 1 percent (Plate 13)
- Mapping of the blowouts indicated that many are truncated on the western side by steep cliffs. The highest concentrations of spent ammunition are generally found in the lower (western) third of the blowouts, above the cliff faces that extend to the beach (Table 4; Plate 11). The bullet concentrations decrease along the cliff faces toward the beach and also to the east, toward the tongue of the blowouts. The bullets appear to be eroding out of the surrounding dunes into the blowouts (troughs between dunes). Subsequently, the effects of gravity and landward migration of sand from westerly winds result in concentration of spent ammunition in the western portion of the blowouts (i.e., in the trough below the dunes from which they eroded).
- Spent ammunition was not observed in the five test pits excavated at the base of the blowouts
- Spent ammunition was not observed in the five surf zone test pits.

4.1.3 Composition of Spent Ammunition

The types of ammunition potentially used at the trainfire ranges were identified by interviewing Fort Ord personnel and reviewing available records, including the Fort Ord Range/Training Area Operating Procedures and Usage Guide (Army, 1991b). The following types of small

arms ammunition were authorized for use at Site 3: 5.56 millimeters (mm), 38- and 45-caliber pistol, 7.62 mm, 7.62 machine gun (MG), and 12 gauge (Army, 1991b). After the types of ammunition used were identified, representative samples of the different types of spent ammunition were collected from the Site 3 study areas during the visual mapping. Additionally, an encrusted bullet sample and a sand sample from nearby Marina State Beach were collected to evaluate the composition of the cemented sand and the clean sand, respectively. The 11 samples were submitted under chain of custody to Northern California Analytical Laboratory, Moraga, California, for elemental composition analyses using x-ray fluorescence (XRF). The XRF analytical technique measures the composition of the exposed exterior and near-surface portion of the sample; it does not provide information regarding the interior composition. To confirm the results of the XRF analyses and provide information about the bulk samples, the same XRF samples were submitted under chain of custody to Enseco, Incorporated (Enseco), West Sacramento, California for digestion and subsequent analysis for priority pollutant and other metals. Enseco is a state-certified laboratory.

The results of the XRF analysis of bullets fragments and sand are presented in Table 5 and Appendix A, and the results of digestion analysis are in Table 6. The characteristics of the spent ammunition at Site 3 follow:

- In general, the XRF results indicated that the bullet fragments were composed primarily of copper, lead, iron, zinc, and antimony (Table 5). Other elements were detected in lesser amounts (in the range of 100 parts per million).
- The exterior of the encrusted bullet sample was composed primarily of iron. Other elements (e.g., aluminum, silicon) were detected at concentrations less than that of iron but generally greater than the concentrations in the bullet fragments. Apparently, weathering of the bullets resulted in an iron oxide substrate that acts as a concentrating medium for other metals

dissolved out of the sand by infiltrating saltwater and rainwater.

- The sand sample was composed primarily of silicon, calcium, aluminum, and sodium
- In general, the results of the digestion analyses confirm the results of the XRF analyses (Table 6). Copper, lead, zinc, antimony, and iron were the more prevalent metals detected in the bullet samples.

4.2 Soil Investigation

4.2.1 Sampling Program

Between November 30 and December 9, 1993, ten test pits were excavated by hand in each of Study Areas 1 and 2; three soil samples were collected from each test pit. The test pit locations in each of the two study areas were selected after completion of the visual mapping as follows:

- Four test pits in areas where surface concentrations of spent ammunition exceeded 10 percent
- Three test pits in areas where surface concentrations of spent ammunition were 1 to 10 percent
- Two test pits in areas where surface concentrations of spent ammunition were less than 1 percent
- One test pit in an area where spent ammunition was not identified at the surface.

In addition, three test pits were excavated in the Control Area and three soil samples were collected from each test pit. The test pits in the Control Area were located within the dune area (two test pits) and on the beach (one test pit). Twenty-three test pits were excavated during this phase of the investigation.

In each test pit, soil samples were collected from the surface, from the encrusted bullet layer, and from 2 feet below the base of the encrusted bullet layer (69 samples). Where no encrusted bullet layer was encountered, samples were collected from the surface and at approximate depths of

0.5 feet and 2.5 feet. Soil samples were collected using a plastic shovel; sufficient material was collected to fill a 5-gallon plastic bucket. The bucket was weighed before and after sample collection to obtain the total mass of each sample. A No. 8 sieve was used to separate the spent ammunition and other fragments from the sand. To confirm the visual estimates at each sampling interval, the metal fragment fraction was weighed to calculate its weight percentage (Table 7). A portion of the sand fraction was then placed in laboratory-supplied, clean glass sample jars for chemical analysis.

In addition to the 69 sieved samples, unsieved samples for leachate analyses were collected from two of the test pits in each of Study Areas 1 and 2 and from one of the test pits in the Control Area. In each of the two study areas, the two test pits were those that had the highest surface concentration of spent ammunition (based on visual estimates); the test pit in the Control Area was from the dune area (S-31). Three samples were collected from each of the five test pits (15 samples total) for leachate analysis. Each sample was collected using a plastic shovel to fill a gallon-size plastic bag; the samples were collected at sampling intervals that corresponded to the soil sampling intervals (surface, encrusted bullet layer, and 2 feet below the encrusted bullet layer). A separate surface sample from each test pit (23 samples) was collected similarly for physical testing. The soil samples for chemical and physical analysis were handled in accordance with the procedures specified in the Sampling and Analysis Plan (SAP) for Fort Ord (HLA, 1991b).

4.2.2 Chemical and Physical Analyses

The sieved and unsieved soil samples collected from the test pits were submitted under chain of custody to Enseco for analyses. The separate surface samples were submitted under chain of custody to Solea Laboratory, Concord, California, for analysis of particle size.

Based on the results of the XRF analyses, the most prevalent and toxic metals detected in the spent ammunition were selected as "indicator" chemicals. The 69 sieved soil samples from the

test pits were analyzed for copper, lead, iron, zinc, antimony, tin, total chromium, and hexavalent chromium using the EPA Test Methods shown in Table 8. All 69 soil samples were also analyzed for cation exchange capacity (CEC), total organic carbon (TOC), and pH using the EPA Test Methods shown in Table 8.

The Waste Extraction Test (WET), the Toxicity Characterization Leaching Potential (TCLP) test, and ASTM D4793-88 test methods were reviewed to evaluate which method would be most appropriate for performing leaching tests at Site 3. All three test methods are designed to evaluate waste leaches and are not specifically intended to approximate field conditions. ASTM D4793-88 was selected because it allows for selection of the leach liquid and thus would be more representative of actual field conditions at the site. This method was proposed in the Draft Final Work Plan, Site 3 (HLA, 1993f) and subsequently approved by the regulatory agencies. Synthetic rainwater and synthetic seawater were selected for use as the leach fluids to approximate actual field conditions where rainwater and saltwater spray might infiltrate into sand containing spent ammunition. A copy of the test method is presented in Appendix E.

The fifteen unsieved samples were submitted to Enseco to be analyzed for leachable metals using the ASTM D4793-88 leaching procedure. Each soil sample was split into four equal fractions by the analytical laboratory. Two fractions were sieved with a No. 8 sieve, and two fractions were not sieved. One set of samples, consisting of one sieved fraction and one unsieved fraction, was leached using synthetic rainwater with a pH of 5.6. The second set of samples was leached using synthetic saltwater with a pH of 8.2. The leachate was analyzed for the same list of metals as were the soil samples (with the exception of hexavalent chromium) using the EPA Test Methods shown in Table 8.

The Site 3 Work Plan called for the soil samples to be analyzed for Eh. However, Eh is a measurement of electron activity in water and no EPA approved laboratory analytical method exists for Eh in soil; therefore, Eh was omitted from the analyte list. Additionally, the leachate test method called for the analysis of 10 leaches from

each sample. Because of cost and practical constraints, only the first leach was analyzed. In general, most of the metals are extracted during the first leaching procedure. Analysis of the first leach was, therefore, considered to represent a worst case scenario and was considered appropriate for Site 3.

4.2.3 Soil Sample Results

The analytical results for soil samples from the Site 3 study and control areas are summarized here and in Tables 9 and 10. A table of the laboratory analytical results is included as Appendix B. Sample depths reported in Appendix B are an average of the total sampling interval. Thus, if the sample interval was 0.5 to 1.0 foot, the depth is reported as 0.75 foot. Particle size analyses are presented in Appendix C.

Soil samples were analyzed from ten test pits in each of the two study areas, and three test pits in the Control Area. Results of the test pit sampling are discussed below.

The analytical results for metals were initially evaluated by comparing the data to maximum background values developed as part of the *Draft Final Basewide Background Soil Investigation*, dated March 15, 1993. Tables 9 and 10 present summaries of the analytical results for the Site 3 soil samples, along with the range of background concentrations, where available. Plates 12 and 13 present concentrations for those metals detected at concentrations greater than each metal's maximum background value. Where detected concentrations are below maximum background values, no data are posted on the plates. No background data from the basewide investigation are available for iron and tin; therefore, concentrations above the detection limit are posted for these metals. Iron, copper, tin, antimony, chromium, lead, and zinc were detected in various soil samples from Study Areas 1 and 2. Hexavalent chromium was not detected in any of the soil samples. Iron was detected in every Site 3 soil sample including those collected in the Control Area.

Background concentrations of lead ranged from 0.52 to 51.8 mg/kg for surface samples (collected

at depths of less than 2 feet), and background concentrations of lead in borehole samples (collected at depths of 10 feet or greater) ranged from 0.68 to 17.4 mg/kg. Soil data at Site 3 will be compared to maximum background concentrations of surface samples because the majority of the samples collected at Site 3 were from near the surface or from shallow soils of depths less than 5 feet.

Lead in soil at Site 3 ranged from 11 to 47,500 mg/kg. Most of the samples that contained lead concentrations greater than the maximum background concentration were above 2.0 feet deep. Only three samples collected below 2 feet contained concentrations above the maximum background value of 51.8 mg/kg: the 2.75-foot sample from Test Pit U-06 in Area 1 and samples collected from 2.25 and 6.25 feet from Test Pit M-02 in Study Area 2. Each of these three samples were collected within 2.5 feet of an encrusted bullet layer.

The only concentrations of zinc, copper, chromium, and antimony detected above maximum background were also from the 2.25 foot sample from Test Pit M-02 and the 2.75 foot sample from Test Pit U-06. Only copper was detected above maximum background in the 6.25 foot sample from Test Pit M-02.

Although iron was detected in every soil sample from Site 3, it is not included as an indicator chemical because it is an essential nutrient, it has a much lower toxicity than lead, and it is also present in samples collected in the Control Area. Because concentrations of metals detected above background are collocated with lead, the focus of the discussion of results at the site is lead. Lead is the most prevalent and the most toxic metal detected at the site and represents the greatest potential risk to human health and the environment. For the purposes of the discussion presented herein, lead concentrations are compared to the maximum background concentration for lead; 51.8 mg/kg.

4.2.3.1 Vertical Distribution

- Based on visual observations and confirmation sampling, concentrations of

spent ammunition are generally highest at the surface (Table 7)

- Where surface concentrations are high (generally above 10 percent), as indicated both by visual estimates and confirmation sampling, an encrusted bullet layer is usually found at an approximate depth of 0.5 foot beneath the surface, with concentrations of spent ammunition dropping to 0 percent within a foot or so beneath the encrusted layer
- Where surface concentrations are low, no bullets are generally found beneath the surface.

4.2.3.2 Lead Concentrations

- Of those metals detected above maximum background, lead was generally detected at the highest concentrations
- Lead was detected at concentrations ranging from 11.0 to 46,300 mg/kg (Plates 14 and 15) during the RI. One sample collected during the Ecological Risk Assessment contained a concentration of 47,500 mg/kg lead.
- Concentrations of lead above 51.8 mg/kg were generally limited to depths of approximately 2 feet or less. One exception was at Test Pit M-02 at Study Area 1, where the encrusted bullet layer extended from depths of approximately 0.5 foot to 4 feet; a lead concentration of 5,390 mg/kg was detected at a depth of 2.25 feet but decreased to 164 mg/kg at 6.25 feet.
- In both study areas, concentrations of lead above 51.8 mg/kg were generally limited to areas where surface concentrations of spent ammunition exceeded 10 percent (Plates 14 and 15). Concentrations of lead above 51.8 mg/kg were also detected in surface samples collected from four test pits where there was moderate (i.e., 3 to 4 percent) surface spent ammunition coverage (Test Pits X-2 in Study Area 1 and M-38, S-38 and G-37 in Study Area 2, Plates 14 and 15).

- Where lead was detected at concentrations below that of metals other than iron (e.g., copper and antimony in samples collected from Test Pit Location 0-9 in Study Area 1), the distribution patterns for these other metals were similar to that for lead
- Concentrations of lead decrease with depth, corresponding to the observed vertical distribution of spent ammunition.

4.2.3.3 Other Analytical Results

- The pH of soil samples collected from the Study and Control areas ranged from 5.1 to 8.3
- TOC concentrations ranged from 229 mg/kg to 4,600 mg/kg; except for a concentration of 14,800 mg/kg detected at 0.12 feet in Test Pit E-35
- Particle size analyses of surface samples indicate that soil types are silty sand (SM) to sand (SP) (Appendix C)
- CECs ranged from 2.0 to 40.3 milliequivalents per 100 grams (meq/100 g). CEC represents the capacity of a soil to attract and accumulate cations. The reported CECs are within the range expected for sand to silty sand (*Dragun, 1988*), and indicate that the amount of clay particles in the samples is low.

4.2.3.4 Leachate Analytical Results

Leachate analyses indicated that rainwater had a greater ability to leach metals from the soil and spent ammunition than did saltwater (rainwater has a lower pH than saltwater). Concentrations of metals leached using rainwater were generally higher than those leached with saltwater for both sieved and unsieved surface samples containing high concentrations of lead (Table 11; Appendix B).

Lead concentrations in leachate samples ranged from ND to 76.6 mg/L. The highest concentrations were in the 0.33 foot sample from Test Pit E-35; 76.6 mg/L from the unsieved rainwater leach and 23 mg/L from the sieved

rainwater leach. Concentrations of lead in the leachate were significantly less than 1 percent of the corresponding total concentration of lead in soil.

As with the distribution of spent ammunition and concentrations of lead in soil samples, the concentrations of lead in the leachate samples decrease by orders of magnitude with depth.

4.3 Air Quality Investigation

4.3.1 Sampling Program

The objective of the air quality investigation was to assess the presence and concentrations of site-related metals entrained in the air. Ambient air samples were collected in Study Area 1 between October 19 and November 6, 1993. High-volume air samplers were placed at three locations expected to be downwind of target areas. Winds in the area generally blow from the west/northwest. The three monitoring stations were placed in a north-south line on the east side of Study Area 1 and a meteorological station was set up nearby to continuously record wind speed and direction, barometric pressure, and air temperature during the sampling effort. At each monitoring station, particulate matter was collected on glass-fiber filters for approximately 8 to 24 hours for each 24-hour monitoring period. Samples collected for less than 24 hours were targeted to represent the most prevalent onshore wind for the 24-hour period. Twenty-eight samples from the three stations and one field blank were retrieved and transported to Enesco for analysis. Total particulate matter was calculated for each sample by weighing the laboratory-conditioned samples. For each 24-hour period, the filter with the highest particulate load was analyzed for selected metals using EPA Test Method 6010 (a total of 10 samples). The metals were lead, zinc, copper, and antimony, which were the most toxic metals detected at the highest concentrations in the soil samples (Section 4.2.3).

The air sampling activities were performed in accordance with the Site 3 Work Plan, except that samples were collected in the fall rather than the summer. Additionally, no samples were collected from Study Area 2 and the Control

Area, and a portion of the samples collected from Study Area 1 were not collected continuously for 24 hours. These deviations were the result of the inconsistent direction of winds during the sampling period in October and November. Samples collected for less than 24 hours appear to represent the most prevalent onshore (westerly) wind during the 24-hour period.

4.3.2 Air Sample Results and Discussion

The analytical results for air samples from Site 3 are summarized below and in Table 12. These results were used qualitatively to aid in the Human Health Risk Assessment presented in Volume III of this report.

- The meteorological station data indicated that wind speed and direction were highly variable throughout the sampling intervals. Therefore, the analytical data were not suitable to quantitatively evaluate airborne metals concentrations derived only from the site, as they would have if the winds had consistently blown from the west. The variable wind direction increases the potential contribution from other sources in the vicinity, including vehicles on Highway 1.
- Ten samples were analyzed for lead, zinc, copper, and antimony. The data were used qualitatively in the risk assessment.
- Lead, copper, and antimony were detected at maximum concentrations of 0.01, 0.06, and 0.002 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), respectively. The national ambient air quality standard for lead set by the EPA is $1.5 \mu\text{g}/\text{m}^3$ (EPA, 1991).
- Zinc was not detected in any of the samples.

4.4 Data Quality Assessment

The analytical data at Site 3 were reviewed to assess whether the data were acceptable considering the data quality objectives (DQOs) of the Site 3 investigation that follow:

- Collect chemical data for soil

- Collect physical soil data so that fate and transport properties of site soils can be assessed
- Refine the list of contaminants at the site
- Assess whether a release of potential contaminants has occurred at the site
- Assess the horizontal and vertical extent of the contaminants in soil at the site
- Collect soil data for site-specific risk assessment. (The Human Health Risk Assessment for Site 3 is presented in Volume III of this report.)
- Collect data consistent with the precision, accuracy, representativeness, completeness, and comparability requirements provided in the SAP.

These DQOs were met for Site 3, and analytical results were validated according to procedures specified in the Fort Ord QAPP (HLA, 1991b Part 2), Revisions to the QAPP (HLA, 1992k), and Part 2 of the *Draft Site Characterization Report, Site 34, Fritzsche Army Airfield Fueling Facility*, dated June 12, 1992. The quality of the data was evaluated by comparison to a set of quality control criteria, including precision, accuracy, and completeness. The quality assurance/quality control (QA/QC) samples used to assess data quality included laboratory duplicate samples; matrix spike/matrix spike duplicates (MS/MSD), blank spike/blank spike duplicates (BS/BSD, also known as laboratory control samples [LCS]); and method blanks. Field duplicates and blanks were not collected during the Site 3 RI. This is discussed in detail in the Introduction to Volume II, Section 2.0 of this report. Holding times and laboratory surrogate spike recoveries were also evaluated. In addition to the routine assessment of precision, accuracy, and completeness, detailed validation, involving review of instrument calibration procedures, calculations, and laboratory data records, was conducted using one sample delivery group (SDG). The results of data validation performed on samples from Site 3, including an evaluation of precision and accuracy, are described in

Appendix D. Table 13 presents laboratory and project qualifiers assigned during data validation.

Results of the data validation indicate that the data are useable when the data quality objectives of the project are considered. The completeness goal of 80 percent was met for all test methods except pH. All samples were analyzed for pH beyond the 24-hour holding time and, therefore, all results were qualified as estimated. Although some results have been qualified, the majority of the qualifiers do not significantly impact the intended use of the data. The following summarizes the identified QC exceedances:

- In 168 sample analyses, results for antimony, copper, iron, lead, and tin were qualified as estimated due to high recoveries for blank spikes or matrix spikes. A high spike recovery can result from either a sample matrix effect or a measurement bias in the analytical system. This could result in the overestimation of the amount of these metals in the associated samples, which would add to the conservativeness of the contamination assessment.
- Thirty-four analytical results for antimony, iron, and zinc were qualified as estimated due to low blank spike or matrix spike recoveries. All of the spike recoveries were above 45 percent. This could result in an underestimation of actual concentrations; including reporting of false negatives. However, for these metals, the laboratory instrument detection limits are at least one-third of the reporting limit for these metals. Therefore, because the laboratory can detect these metals well below their respective reporting limits, it is unlikely that false negatives were reported. In addition, these metals are generally co-located with lead, which is the primary chemical of concern.
- In 118 sample analyses, results for antimony, chromium, iron, lead, and tin were qualified as estimated because laboratory duplicate precision criteria were not met. Duplicate precision criteria are a measure of the stability of the analytical system. They do not indicate that instrument sensitivity is affected, and the potential for false negatives or false positives is very low.
- Twenty sample analytical results for zinc were qualified as estimated because the serial dilution criterion for inductively coupled plasma (ICP) was not met. Serial dilution outside control limits indicates a sample matrix effect that varies as the sample is diluted. This does not indicate that instrument sensitivity is affected, and the potential for false negatives or false positives is very low because samples containing low concentrations would not be significantly diluted.
- Twenty sample analytical results for antimony and chromium were qualified due to matrix spike recoveries below 30 percent. Of these, nine results for antimony were "Not Detected" (ND) and qualified as rejected. The remaining sample results were detected and were qualified as estimated. When the spike recovery is below 30 percent, the potential for reporting false negatives is significant. Antimony and chromium are generally co-located with lead, which is the primary contaminant.
- Four SDGs had hexavalent chromium (CrVI) matrix spike recoveries below the control limit; three of the spike recoveries were below 30 percent. Matrix spike samples were reanalyzed and similar recoveries were obtained. BS/BSD data indicate that the method was in control. MS data indicate that the method, as applied to the site-specific sample matrix, produces unreliable results. CrVI analysis is unique with respect to the stability of the analyte in the matrix; under most field and laboratory analytical conditions, CrVI in soil will be rapidly reduced to trivalent chromium (CrIII), thus rendering the CrVI matrix spike data inconclusive. A U.S. Department of Health and Human Services toxicological profile for chromium (*Carey and Saleh, et al.*) notes "the reduction of CrVI to CrIII is possible in aerobic soils that contain appropriate organic energy sources to carry out the redox reaction. The reduction of CrVI to CrIII is facilitated by low pH." (*ATSDR, 1993a*).

Data validation guidelines and data qualification protocol do not provide for an appropriate mechanism to address CrVI data quality under these unique circumstances. Therefore, the N2 (Not Qualified) code has been applied to the CrVI results. HLA believes that the CrVI data is usable even when associated with poor QC results, because matrix spike data indicate that soil conditions at the site do not favor the formation or stability of CrVI. This belief is supported by work performed by Rai, Eary, and Zachara, who noted that "commonly occurring reductants, such as ferrous iron and organic material, can transform Cr(VI) to Cr(III)." (*Rai et al., 1989*).

5.0 SUMMARY OF THE RI AT SITE 3

This section summarizes the results of RI field activities at Site 3.

5.1 Source Characterization

Copper, lead, iron, zinc, and antimony are the primary components of spent ammunition at the site. Lead is the main contaminant because its concentrations in soil samples are among the highest and it has a high toxicity. Where other metals were detected at higher concentrations (e.g., copper and antimony in Test Pit O-9 in Study Area 1 at 0.13 foot), their distribution patterns were similar to that of lead in other test pits. Although iron was detected most often and at the highest concentrations, it was not considered to be a contaminant because it was detected in all soil samples (including those collected from the Control Area), it is an essential nutrient, and it has a much lower toxicity than does lead.

5.1.1 Spent Ammunition

The distribution and composition of spent ammunition was investigated; the results are described below:

- Spent Ammunition Distribution: The most effective way to evaluate the distribution of spent ammunition (i.e., the source of the contamination) at the site was visual mapping. Geophysical methods were unreliable because of soil moisture variations across the site. Although the metal detector could be used to qualitatively evaluate the presence of high concentrations (greater than approximately 5 percent) of spent ammunition, its effectiveness was limited to the upper 6 inches of soil.

The concentration of spent ammunition is generally highest (greater than 10 percent) in a band along the sand dunes immediately behind the targets. Between the firing lines and the targets and flanking the heavy concentrations of bullets, extending to the tops of the dunes, the concentration of spent ammunition is moderate

(1 to 10 percent). Between ranges and from the tops of the dunes to the shoreline (with the exception of blowout areas) the concentrations of spent ammunition exceed 10 percent, an encrusted bullet layer is found at an approximate depth of 0.5 foot and extends to depths between 1.0 to 2.0 feet, except in Test Pit M-2 in Study Area. Generally, no bullets are found beneath the encrusted layer. Where surface concentrations of spent ammunition are low, no bullets were encountered beneath the surface. In each blowout, the distribution of spent ammunition is highest in the western portion of the blowout, directly above the shoreline cliff that rises above the beach; the concentration in the blowouts decreases both landward (eastward) and down the cliff face. No bullets were detected in test pits at the base of the blowouts or in the surf zone.

- Spent Ammunition Characteristics: The results of the XRF analyses and digestion of the bullet samples. Spent ammunition at the site is composed primarily of copper, lead, iron, zinc, and antimony.

5.2 Soil Contamination Investigation

Analytical results from soil samples collected during the RI indicated that antimony, copper, chromium, lead, and zinc were present above their background concentrations. Iron and tin were also detected in the soil samples; background data are not available for these two metals. Iron, however, was present at similar concentrations in most areas sampled, including the Control Area, and is thought to be present at site-specific background levels. Hexavalent chromium was not detected in any of the soil samples.

Of the detected metals, lead is considered the primary contaminant based on its concentration, frequency of detection, and toxicity. Copper, zinc, and antimony detected above maximum background values were collocated with lead.

The highest concentrations of lead in soil were detected where surface concentrations of spent ammunition were greater than 10 percent (shown in red on Plates 14 and 15); in these areas, the lead concentrations in sieved surface soil samples ranged from 457 mg/kg at Test Pit O-9 in Study Area 1 to 46,300 mg/kg at Test Pit I-35 in Study Area 2. One sample collected in Study Area 1 during the Ecological Risk Assessment contained 47,500 mg/kg lead, the highest concentration detected.

An encrusted bullet layer was observed beneath the surface (0 to 0.25 foot deep) and extended to depths of approximately 1 to 2 feet bgs in most areas where the surface concentration of bullets was greater than 10 percent and in some areas where surface concentrations were 1 to 10 percent.

Lead concentrations were compared to a screening concentration of 51.8 mg/kg, which is the maximum background concentration for lead. Concentrations of lead above 51.8 mg/kg were limited to depths of 2 feet or less, with 3 exceptions: Test Pit U-06 at 2.75 feet and in Test Pit M-02 at 2.25 and 6.25 feet. These samples were collected within 2.5 feet on an encrusted bullet layer. Lead concentrations decrease by orders of magnitude with depth corresponding to the vertical distribution of spent ammunition. .

Other analyses indicated that the surface soils consist of silty sand to sand, with a pH range of 5.1 to 8.3, and that TOC and CECs concentrations are low.

5.3 Air Sampling Investigation

Because of highly variable wind conditions, quantitative assessment of airborne contaminants originating only from Site 3 was not possible. Winds from directions other than the west have the potential of carrying contaminants from other areas (e.g., lead in soil near roadways such as Highway 1). The air sampling data collected from Study Area 1, therefore, were used qualitatively in the Baseline Human Health Risk Assessment (Volume III of this report). The results of the air sampling at Study Area 1

showed detected concentrations of lead, antimony, and copper.

5.4 Leachate Analysis

Leachate analysis indicated that rainwater had a greater ability to leach metals from the soil and spent ammunition than did saltwater (rainwater has a lower pH than saltwater). Leachate concentrations decreased with depth corresponding to decreasing lead concentrations in soil and were significantly less than 1 percent of the total concentration of lead in soil.

6.0 CONCLUSIONS OF THE RI AT SITE 3

This section summarizes the conclusions of the RI at Site 3, including the source and extent of potential contamination in the soil, effects on air quality, and effects on groundwater quality. The potential effects on human and ecological resources are discussed in Volumes III and IV of this report. The recommended remedial actions are discussed in Volume V of this report.

6.1 Source and Extent of Soil Contamination

Based on the data collected during the RI, the source of metals contamination in soil at Site 3 appears to be spent ammunition. Because the results from both study areas were similar (i.e., no relation to age or usage of the ranges) and because visual mapping was the most effective way to estimate spent ammunition distribution across the site, results of the quantitative sampling in the study areas were applied at the remainder of Site 3.

Therefore, Plates 14 and 15, which show the distribution of spent ammunition, also show the relative horizontal distribution of lead in soil. Based on the investigations of the two study areas and extrapolation of these results to the remainder of Site 3, the horizontal extent of contamination at Site 3 has been adequately defined. The vertical distribution of lead in soil is defined by the presence of an encrusted bullet layer, the base of which extends to a depth of approximately 2.0 feet in most areas where concentrations of spent ammunition are greater than 10 percent. This layer extends to 4.0 feet in the vicinity of Test Pit M-02. The data appear to indicate that concentrations of lead are below or approaching maximum background concentrations within 2.5 feet of this encrusted layer. Sufficient data have been collected for the Human Health Risk Assessment, Ecological Risk Assessment and Feasibility Study.

6.2 Fate and Transport of Contaminants at Site 3

Based on the results of the RI, the primary contaminants at Site 3 are lead, iron, zinc, antimony, and copper. These metals are components of the spent ammunition found at the surface and in the subsurface and are detected in the associated soil at concentrations above maximum background. Potential transport media for these metals are air, surface water (runoff), unsaturated zone soil, and groundwater. The following sections discuss the initial pathways that were identified (Section 6.2.1), the physical and chemical characteristics of the metals that control their mobility and persistence (i.e. fate) in the environment (Section 6.2.2), and the migration (i.e. transport) pathways that appear to be viable at Site 3 based on data collected during the RI (Section 6.2.3).

6.2.1 Pathway Identification

Prior to collecting data for the RI, a conceptual model was developed to identify potential exposure pathways and migration mechanisms for the anticipated contaminants. Pathways by which humans or biota would be exposed (exposure pathways) are described in Section 3.0 and were evaluated during the Human Health and Ecological Risk Assessments presented as Volumes III and IV, respectively, of this RI/FS report. Potential chemical migration mechanisms at Site 3 were discussed in Section 3.3 and formed the basis for the field activities conducted during the RI. Based on the configuration of the site, the local conditions (e.g., topography, wind speed and direction), and the assumed contaminant source (i.e., the spent ammunition), the following migration mechanisms were identified:

- Migration of spent ammunition to the surf zone through erosion
- Leaching or mechanical erosion (weathering) of metals from the spent ammunition to the unsaturated soil

- Leaching of metals through the soil to groundwater
- Migration of dissolved metals within and between aquifers
- Discharge of groundwater containing metals to Monterey Bay
- Entrainment in air of metals adsorbed to dust particles
- Bioaccumulation of chemicals by organisms, and migration to other ecological receptors via the food web.

6.2.2 Mobility and Persistence of Metals

Weathering of spent ammunition has leached lead, iron, copper, zinc, and antimony into the soil at Site 3. The mobility and persistence of these metals in the environment are influenced by the amount, form, and oxidation state of the metal and by the composition and physiochemical properties of the soil. The amount of metal is determined by an area's location relative to a target area and backstop; densities of spent ammunition are shown on Plates 11, 12, and 13. Because the contaminant source is the spent ammunition, these metals appear to be present in their elemental form or as oxides. Soil properties that may affect the fate and transport of these metals include: bulk density, surface area, particle size distribution, pH, oxidation/reduction potential, cation exchange capacity (CEC), salinity, and type and concentration of organic matter, clay minerals, and oxides. A more detailed discussion of how each of these properties affects fate and transport is presented in the Introduction to Volume II, Section 3.0. Particle size distribution, CEC, pH, and total organic carbon (TOC) data were collected during the RI to assist in evaluation of metal retention and release processes in soil at Site 3.

Lead, Copper, and Zinc

Lead, copper, and zinc generally behave similarly in terms of their persistence in soil. Because lead is the most toxic of these three metals, and

because the highest concentrations of copper and zinc are collocated with elevated concentrations of lead at Site 3, mobility and persistence of these metals will be discussed in terms of lead.

Particle size distribution data indicate that soil at the site is primarily silty sand to sand and the CEC ranged from 2.0 to 40.3 milliequivalents per 100 grams. Although the soil contains very little clay, the CEC values are within a range that would favor retention of lead. TOC concentrations ranged from 229 mg/kg to 4,600 mg/kg, with one sample containing a concentration of 14,800 mg/kg. The pH of the soil samples collected ranged from 5.1 to 8.3. TOC and pH data are within a range that would also favor retention of lead. Particle size distribution, CEC, TOC, and pH are interrelated in governing contaminant persistence. These site specific data were used in a qualitative assessment of the persistence of lead in soil as discussed below.

Lead leached from a source (i.e., spent ammunition) reacts with clays, phosphates, sulfates, carbonates, hydroxides, and organic matter in soil, and greatly reduces the solubility and, hence, the mobility of lead. Soil pH greatly affects the retention of lead in soil.

Generally, soil with a pH of 6.0 or greater will cause lead to adhere to the soil or form lead compounds. Lead has a strong affinity for forming carbonate and oxide compounds, which also increases retention of lead, thus reducing its mobility. The presence of iron in an oxidizing state could cause the formation of lead oxide compounds, which are also highly insoluble. This is evident at Site 3. The encrusted bullet layer correlates with the highest concentrations of lead and appears to be acting as an iron oxide substrate, concentrating the lead and other metals.

Antimony

Very limited data are available regarding the behavior of antimony in soil; however, antimony is expected to exhibit behavior similar to arsenic because of their similar chemical properties. Based on the behavior of arsenic, antimony would have increasing solubility in soils with a pH of 7 or greater. As with arsenic, antimony

might be expected to form insoluble precipitates with iron, aluminum, and calcium (*Adriang, 1986*).

Iron

Iron was detected in all samples collected at Site 3, including those in the Control Area and, in addition to being a primary component of spent ammunition, is also considered to be naturally occurring. Therefore, its mobility and persistence in soil will not be discussed. However, as discussed above, iron is significant in that it affects the fate of lead in soil. The presence of iron in an oxidizing state promotes the formation of lead oxides, thus increasing adsorption of lead to soil particles and reducing its mobility.

6.2.3 Pertinent Migration Pathways at Site 3

Using the data generated during the RI, each of the potential chemical migration pathways (Section 6.2.1) was assessed. These evaluations are discussed below.

Migration of Spent Ammunition to the Surf Zone

This pathway was evaluated by excavating test pits in the surf zone (Section 4.1.2). No spent ammunition was found, and results of soil samples analyses indicated that metals were not present above maximum background; therefore, this pathway is not considered further.

Leaching of Metals from Spent Ammunition to Soil.

Some leaching of spent ammunition to the soil has occurred at Site 3, as evidenced by concentrations higher than background of iron, lead, copper, zinc, and antimony in soil samples collected during the RI. There is likely some contribution to these elevated concentrations from bullet fragments finer than a #8 sieve. Once in the soil, these metals (except antimony) would likely not migrate given the soil's pH conditions, CEC, TOC, and the presence of an iron oxide substrate (encrusted bullet layer), which acts as a concentrating medium in the

upper few feet of soil. This encrusted bullet layer is present in heavily bulletted areas at depths of approximately 0.5 to 2.0 feet (extending to 4.0 feet in Test Pit M-02 in Study Area 1). The site's soil properties and the vertical distribution of lead indicate that there has been only limited vertical migration of lead. Within 2.5 feet of the encrusted bullet layer, lead concentrations decrease to near maximum background levels. For example, the highest concentration of lead detected during RI sampling was 46,300 mg/kg at 0.08 feet deep, which decreased to 51.1 mg/kg at 1.75 feet. Only three samples collected below 2.0 feet deep contained concentrations of lead above the maximum background level of 51.8 mg/kg. All three samples were collected within 2.5 feet of an encrusted bullet layer. The deepest sample collected at 6.25 feet in Test Pit M-02 contained a lead concentration of 164 mg/kg. The distributions of other metals (copper, zinc, and antimony) detected above maximum background were similar to that of lead and also indicate limited leaching of the metals found at or near the surface.

Leaching of Metals from Soil to Groundwater

The limited mobility of lead in the soil at Site 3 is shown by the order-of-magnitude decrease in concentration of lead with depth. Data indicate that lead concentrations decrease to near maximum background levels within 2.5 feet below the encrusted bullet layer. As previously mentioned, other metals present above maximum background concentrations (zinc, copper, and antimony) appear to be collocated with lead and show a similar distribution. These data indicate that the metals have not migrated significantly in the unsaturated zone at Site 3 and, thus, have not likely migrated to groundwater.

This interpretation is supported by the available groundwater data (Section 1.4.1). Lead has not been detected in groundwater samples collected from Monitoring Well MW-02-10-180. This well is in an area where groundwater is relatively shallow (approximately 40 feet bgs) and is within 20 feet of a heavily bulletted dune face. Lead was also not detected in two wells (MW-02-02-180 and MW-02-08-180) that are downgradient of heavily bulletted area. These data indicate that

migration through the unsaturated zone to groundwater is not considered a likely pathway at Site 3.

Because groundwater has not been impacted by lead, migration of dissolved metals within and between aquifers and discharge of lead-contaminated groundwater to Monterey Bay are not considered to be viable migration pathways at Site 3.

Entrainment in Air of Metals Adsorbed to Dust Particles

Air samples were collected and analyzed (Section 4.3). Because of variable wind patterns, it was not possible to isolate site-specific effects from those possibly originating from other sources (e.g., nearby roadways). Therefore, this migration pathway remains plausible; the significance of this pathway is discussed further in the Human Health Risk Assessment, Volume III of this report.

Bioaccumulation of Metals by Organisms, Such as Plants, and Migration to Other Ecological Receptors Via the Food Web

Data collected during the RI, and additional soil and plant samples collected as part of the Ecological Risk Assessment, are discussed in Section 1.4.4 and are presented in more detail in Volume IV of this report. The significance of this pathway is discussed further in Volume IV.

Potentially contaminated surface water runoff discharged from the storm drain or stormwater beach outfalls to surface water or soil at Site 3 was evaluated during the Basewide Surface Water Outfall Investigation (BWSWOI) discussed in Section 1.4.3 and in the Basewide Outfall Investigation (BWOI) in Volume II. No catch basins are present within Site 3; and because of the high porosity of the dune sands, a significant amount of runoff is not anticipated at the site. Therefore, it is not considered a viable pathway at Site 3.

6.3 Effects on Air Quality

Lead, copper, and antimony were detected in the air samples. Because of the variability in wind

direction during the sampling period at Study Area 1, the analytical chemistry data did not represent metals concentrations derived only from Site 3. Therefore, these results were not used in the risk assessment air pathway evaluation. Contaminant migration in air was evaluated using a regional airborne dust concentration and assuming chemical concentrations in dust equivalent to chemical concentrations in soil. This approach results in conservative estimates of potential particulate inhalation exposures and is described in detail in Section 2.2.8 of Volume III.

Results of the air pathway evaluation indicated no concentrations above EPA threshold levels of concern; therefore, there is little risk of exposure (to lead and other metals from Site 3) via inhalation from airborne dust. More detailed information is presented in the Human Health Risk Assessment, Volume III of this report.

6.4 Potential Groundwater Contamination

Based on results of the first three tasks of this RI, a groundwater investigation was not considered necessary. Evaluation of soil sampling data, leachate data, and data collected as part of other site investigations indicates that the potential for groundwater contamination by lead is low for the following reasons:

- Lead is very persistent in soil, and the pH, TOC, CEC, and iron data suggest that soil conditions at Site 3 favor retention of metals. Analytical results for the soil samples indicate that metals concentrations, lead in particular, decrease by orders of magnitude with depth and correspond to the vertical distribution of spent ammunition. This decrease of lead concentrations with depth indicates that extensive leaching and migration of lead had not occurred at Site 3.
- Concentrations of lead in soil greater than maximum background (51.8 mg/kg) were not detected below depths of 2 feet, except in Test Pit U-06 (806 mg/kg at 2.75 feet) and Test Pit M-02 (5,390 mg/kg at 2.25 feet, which decreased to 164 mg/kg at 6.25 feet deep); and the concentrations are related to

the presence of an encrusted bullet layer. This layer formed of iron oxides apparently acts as a concentrating medium for metals, further decreasing their mobility.

- Leachate results indicate that lead could be leached from the soil using rainwater; however, soil sample results and an evaluation of fate and transport properties of lead indicate that extensive leaching of lead and other metals has not occurred. Therefore, the results of the leach tests do not appear representative of actual field conditions.
- Monitoring Well MW-02-10-180 was installed in Range 11 as part of the Site 2 RI. The well is located within 20 feet in a crossgradient direction of a heavily bulletted dune face and groundwater data indicate that gradients in this area are relatively flat. Because rainwater would infiltrate through high concentrations of spent ammunition located on the dune face and because groundwater is shallowest in this area (given the topography), this well is considered to represent a worst case scenario. Lead was not detected and priority pollutant metals were not detected above their MCLs in this well. Lead was also not detected in samples from Monitoring Wells MW-02-02-180 and MW-02-08-180, approximately 500 feet downgradient of a heavily bulletted area in Range 9. These results also suggest that groundwater has not been impacted by lead to date.

Risk-based target cleanup levels (TCLs) were calculated for Site 3 and are presented in the Baseline Human Health Risk Assessment (Volume III of this report). A TCL for lead of 1,860 mg/kg for a child and 4,192 mg/kg for an adult were calculated based on a recreational use scenario. The TCLs were used to evaluate potential remedial options and will be used as remediation goals for proposed future cleanup at Site 3. As part of remedial activities, a pilot study will be performed to evaluate the effectiveness of site remediation. These activities are described in detail in the Feasibility Study, Volume V of this report.

6.5 Related Activities at Site 3

Related and future planned activities at Site 3 consist of an Enhanced Preliminary Assessment of Monterey Bay and the performance of a feasibility study to evaluate potential remedial options.

An evaluation of whether historic and/or current conditions at and around Fort Ord (including Site 3) have impacted the restricted zone in Monterey Bay was presented in HLA's *Draft Enhanced Preliminary Assessment of Monterey Bay, Fort Ord, California* October 27, 1994.

TABLES

Table 1. Possible Ecological Receptors with Special Status - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Category/Common Name	Scientific Name	Status* Federal/State/CNPS
<u>Invertebrates</u>		
Smith's blue butterfly	<i>Euphilotes enoptes smithi</i>	FE/--/--
<u>Reptiles</u>		
California black legless lizard	<i>Anniella pulchra nigra</i>	C2/CSC/--
<u>Birds</u>		
Western snowy plover	<i>Charadrius alexandrinus nivosus</i>	FT/CSC/--
Loggerhead shrike	<i>Lanius ludovicianus</i>	C2/CSC/--
Merlin	<i>Falco columbarius</i>	--/CSC/--
<u>Plants</u>		
Menzies' wallflower	<i>Erysimum menziesii</i> ssp. <i>menziesii</i>	FE/SE/1B
Sand gilia	<i>Gilia tenuiflora</i> ssp. <i>arenaria</i>	FE/ST/1B
Robust spineflower	<i>Chorizanthe robusta</i> var. <i>robusta</i>	FE/--/1B
Monterey spineflower	<i>Chorizanthe pungens</i> var. <i>pungens</i>	FT/--/1B
Seaside bird's-beak	<i>Cordylanthus rigidus</i> ssp. <i>littoralis</i>	C1/SE/1B
Yadon's piperia	<i>Piperia yadonii</i>	C1/--/1B
Sandmat manzanita	<i>Arctostaphylos pumila</i>	C2/--/1B
Monterey ceanothus	<i>Ceanothus cuneatus</i> var. <i>rigidus</i>	C2/--/4

Table 1. Possible Ecological Receptors with Special Status - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Category/Common Name	Scientific Name	Status*
		Federal/State/CNPS
Coast wallflower	<i>Erysimum ammophilum</i>	C2/--/1B
Kellogg's horkelia	<i>Horkelia cuneata</i> ssp. <i>sericea</i>	C2/--/1B
Monterey Indian paintbrush	<i>Castilleja latifolia</i>	--/--/4

CNPS California Native Plant Society
ssp. Subspecies.
var. variety

* Status:
-- No status

Federal

FE Listed as endangered under the federal Endangered Species Act (16 U.S.C. 1531 et seq.).
FT Listed as threatened under the federal Endangered Species Act (16 U.S.C. 1531 et seq.).
C1 Category 1 Candidate for listing under the federal Endangered Species Act (16 U.S.C. 1531 et seq.). Sufficient biological information is available to support a proposal to list taxa as endangered or threatened.
C2 Category 2 Candidate for listing under the federal Endangered Species Act. Existing information indicates taxa may warrant listing, but substantial biological information necessary to support a proposed rule is lacking.

State

SE Listed as endangered under the California Endangered Species Act (California Fish and Game Code Chapter 1.5).
ST Listed as threatened under the California Endangered Species Act (California Fish and Game Code Chapter 1.5).
CSC California Species of Special Concern.

California Native Plant Society (CNPS)

1B Plants considered by CNPS as rare in California and elsewhere.
4 Plants CNPS considers to have limited distributions--a watch list.

Table 2. Fort Ord Water-Level Data, August 1993 - June 1994
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California

Station Name	Date	Top of Casing Elevation (feet)	Depth to Water (feet)	Water- Level Elevation (feet)	Water in Well (feet)	Comments
<u>OU2 LANDFILL</u>						
MW-OU2-04-A	6/01/94	111.56	64.45	47.11	20.05	
MW-OU2-05(PA1)-A	8/25/93	149.32	98.79	50.53	31.11	
	12/03/93	149.32	98.73	50.59	31.17	
	2/16/94	149.32	98.66	50.66	31.24	
	6/01/94	149.32	98.99	50.33	30.91	
MW-OU2-05(PA2)-A	8/25/93	143.86	93.23	50.63	29.27	
	12/03/93	143.86	93.21	50.65	29.29	
	2/16/94	143.86	93.15	50.71	29.35	
	6/01/94	143.86	93.46	50.40	29.04	
MW-OU2-05-A	8/25/93	149.05	98.46	50.59	29.24	
	12/03/93	149.05	98.47	50.58	29.23	
	2/16/94	149.05	98.34	50.71	29.36	
	6/01/94	149.05	98.45	50.60	29.25	
MW-OU2-06-180	8/25/93	154.10	167.18	(13.08)	138.82	
	12/03/93	154.10	164.42	(10.32)	141.58	
	2/16/94	154.10	161.46	(7.36)	144.54	
	6/01/94	154.10	164.10	(10.00)	141.90	
MW-OU2-06-400	8/25/93	153.80	166.47	(12.67)	371.93	
	12/02/93	153.80	163.82	(10.02)	374.58	
	2/16/94	153.80	160.94	(7.14)	377.46	
	6/01/94	153.80	166.00	(12.20)	372.40	
MW-OU2-06-A	8/25/93	154.82	100.95	53.87	28.05	
	12/02/93	154.82	100.93	53.89	28.07	
	2/16/94	154.82	100.96	53.86	28.04	
	6/01/94	154.82	101.08	53.74	27.92	
MW-OU2-07-180	8/25/93	175.92	189.84	(13.92)	163.36	
	12/02/93	175.92	186.97	(11.05)	166.23	
	2/16/94	175.92	183.88	(7.96)	169.32	
	6/01/94	175.92	186.53	(10.61)	166.67	
MW-OU2-07-400	8/25/93	174.98	188.68	(13.70)	390.72	
	12/03/93	174.98	185.48	(10.50)	393.92	
	2/16/94	174.98	182.67	(7.69)	396.73	
	6/01/94	174.98	189.60	(14.62)	389.80	
MW-OU2-07-A	8/25/93	176.84	116.94	59.90	25.56	
	12/03/93	176.84	116.81	60.03	25.69	
	2/16/94	176.84	116.78	60.06	25.72	
	6/01/94	176.84	117.12	59.72	25.38	
MW-OU2-08-A	8/25/93	160.10	93.31	66.79	34.19	
	12/02/93	160.10	93.39	66.71	34.11	
	2/16/94	160.10	93.35	66.75	34.15	

**Table 2. Field Activities Conducted, RI Program - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California**

Field Activity	Objective/ Goal	Study Area 1	Study Area 2	Control Area	Sitewide
Evaluation of Spent Ammunition Characteristics	To obtain representative spent ammunition samples for metals analysis				11 representative samples collected
<u>Soil Sampling</u>		<u>Test Pit Number</u>	<u>Test Pit Number</u>	<u>Test Pit Number</u>	
Test Pit Sampling	To provide quantitative information regarding metals concentrations in soil	Area 1 - X-2 Area 1 - U-6 Area 1 - O-9 Area 1 - K-13 Area 1 - M-2 Area 1 - D-1 Area 1 - K-4 Area 1 - I-9 Area 1 - E-15 Area 1 - C-14	Area 2 - E-35 Area 2 - I-35 Area 2 - G-37 Area 2 - L-39 Area 2 - G-43 Area 2 - S-38 Area 2 - P-39 Area 2 - M-38 Area 2 - S-19 Area 2 - M-41	Control - S-31 Control - A-31 Control - (Beach)	None
Leachate Analyses	To provide quantitative information regarding metals concentrations leaching from soil	Area 1 - M-2 Area 1 - U-6	Area 2 - E-35 Area 2 - I-35	Control - S-31	None
<u>Air Sampling</u>	To provide information regarding concentrations of airborne metals originating from Site 3	Completed	None	None	None

Table 2. Fort Ord Water-Level Data, August 1993 - June 1994
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California

Station Name	Date	Top of Casing Elevation (feet)	Depth to Water (feet)	Water- Level Elevation (feet)	Water in Well (feet)	Comments
<u>OU2 LANDFILL</u>						
MW-OU2-23-180	8/25/93	182.35	191.58	(9.23)	48.42	
	12/02/93	182.35	191.52	(9.17)	48.48	
	2/16/94	182.35	189.41	(7.06)	50.59	
	6/02/94	182.35	190.04	(7.69)	49.96	
MW-OU2-23-A	8/25/93	182.05	119.05	63.00	14.95	
	12/02/93	182.05	119.07	62.98	14.93	
	2/16/94	182.05	119.10	62.95	14.90	
	6/02/94	182.05	119.15	62.90	14.85	
MW-OU2-24-180	8/25/93	181.23	193.93	(12.70)	37.07	
	12/02/93	181.23	192.04	(10.81)	38.96	
	2/16/94	181.23	189.08	(7.85)	41.92	
	6/01/94	181.23	191.07	(9.84)	39.93	
MW-OU2-25-A	8/25/93	215.42	136.35	79.07	22.65	
	12/02/93	215.42	136.26	79.16	22.74	
	2/16/94	215.42	136.19	79.23	22.81	
	6/02/94	215.42	136.28	79.14	22.72	
MW-OU2-26-A	8/25/93	215.30	124.76	90.54	24.24	
	12/02/93	215.30	124.76	90.54	24.24	
	2/17/94	215.30	124.65	90.65	24.35	
	6/02/94	215.30	124.12	91.18	24.88	
MW-OU2-27-A	8/25/93	185.66	98.62	87.04	26.88	
	12/02/93	185.66	98.79	86.87	26.71	
	2/16/94	185.66	98.50	87.16	27.00	
	6/02/94	185.66	98.02	87.64	27.48	
MW-OU2-28-180	8/25/93	198.20	216.60	(18.40)	38.40	
	12/02/93	198.20	215.30	(17.10)	39.70	
	2/16/94	198.20	211.16	(12.96)	43.84	
	6/02/94	198.20	212.32	(14.12)	42.68	
MW-OU2-28-400	8/25/93	198.33	216.53	(18.20)	221.47	
	12/02/93	198.33	215.02	(16.69)	222.98	
	2/16/94	198.33	210.96	(12.63)	227.04	
	6/02/94	198.33	212.20	(13.87)	225.80	
MW-OU2-28-A	8/25/93	198.04	76.04	122.00	59.96	
	12/02/93	198.04	111.94	86.10	24.06	
	2/16/94	198.04	111.60	86.44	24.40	
	6/02/94	198.04	111.33	86.71	24.67	
MW-OU2-29-180	8/25/93	252.78	265.19	(12.41)	24.31	
	12/02/93	252.78	266.33	(13.55)	23.17	
	2/16/94	252.78	264.14	(11.36)	25.36	
	6/02/94	252.78	263.82	(11.04)	25.68	
MW-OU2-29-A	8/25/93	253.39	159.09	94.30	20.41	
	12/02/93	253.39	159.11	94.28	20.39	
	2/16/94	253.39	158.91	94.48	20.59	
	6/02/94	253.39	159.01	94.38	20.49	
MW-OU2-30-180	8/25/93	163.59	181.10	(17.51)	38.90	
	12/02/93	163.59	178.90	(15.31)	41.10	

Table 3. Bullet Distribution at Confirmation Sampling Locations - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Study Area	Confirmation Sampling Location (Grid Nodes)	Visual Observation at Surface (% Bullets)	Total Weight of Bullets and Sand (Vol. of 1"x3'x3') (lbs)	Sieved Bullet Weight (lbs)	Weight Percent of Bullets
	M-13	0	87.6	0.329	0.38
	M-7	0	81.2	0	0
	M-1	0	86.0	0	0
<u>Study Area 2</u>	S-1	0	92.2	0	0
	S-7	0	55.4	0	0
	S-13	0	80.4	0	0
	S-19	0	77.0	0.021	0.027
	S-25	0	93.6	0	0
	S-31	0	55.4	0	0
	S-38	1-2	78.0	1.263	1.62
	Y-36	0	62.6	0	0
	Y-31	0	75.6	0	0
	Y-25	0	55.4	0	0
	Y-19	0	42.2	0	0
	Y-13	0	62.2	0	0
	Y-7	0	48.4	0	0
	Y-1	0	45.6	0	0
	I-35	55	123.4	59.4	48.29
	E-35	45	111.2	36.4	32.73
<u>Control Area</u>	A-1	0	44.4	0	0
	A-7	0	38.0	0.026	0.068
	A-13	0	29.4	0.019	0.065
	A-19	0	43.0	0.040	0.093
	A-25	0	83.4	0	0
	A-31	0	90.6	0.005	0.006
	G-25	0	80.4	0.002	0.002
	G-19	0	66.4	0	0
	G-13	0	41.0	0	0
	G-7	0	46.1	0.007	0.015
	G-1	0	51.8	0.002	0.004
	M-1	0	53.4	0	0
	M-7	0	52.0	0	0
	M-13	0	87.0	0	0
	M-19	0	58.4	0	0
	M-25	0	57.8	0.015	0.026
	M-31	0	86.4	0	0
	S-1	0	71.4	0	0
	S-13	0	54.9	0	0
	S-19	0	74.0	0	0
	S-25	0	58.0	0	0
	S-31	0	60.8	0	0

Table 3. Bullet Distribution at Confirmation Sampling Locations - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Study Area	Confirmation Sampling Location (Grid Nodes)	Visual Observation at Surface (% Bullets)	Total Weight of Bullets and Sand (Vol. of 1"x3'x3') (lbs)	Sieved Bullet Weight (lbs)	Weight Percent of Bullets
	Y-13	0	61.4	0	0
	Y-7	0	31.8	0	0
	Y-1	0	35.6	0	0

Table 4. Bullet Distribution at Blowouts - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Blowout Number	Range Number	Test Pit Number	Visual Observation at surface (% bullets)	Total Weight of Bullets and Sand (Vol. of 1"x3'x3') (lbs)	Sieved Bullet Weight (lbs)	Weight Percent of Bullets
<u>Blowout 1</u>	15 & 16	2A	0	NA	NA	NA
	15 & 16	1A	<1	66.8	0	0
	15 & 16	1B	<1	63.4	0	0
	15 & 16	1C	>10	99.0	8.2	8
	15 & 16	1D	>10	91.4	7.4	8
	15 & 16	1E	0	90.0	0	0
	15 & 16	1F	0	87.9	0	0
<u>Blowout 2</u>	11	2A	0	NA	NA	NA
	11	3A	0	NA	NA	NA
	11	3	0	NA	NA	NA
	11	1A	0	107.0	0	0
	11	1D	1-10	96.2	1.9	2
	11	1C	>10	87.6	3.1	4
	11	1B	>10	93.6	2.8	3
	11	1E	<1	67.8	0	0
	11	1F	<1	72.2	0	0
<u>Blowout 3</u>	Control	1A	<1	104.2	0	0
	Control	1B	<1	85.6	0	0
	Control	1C	0	81.6	0	0
	Control	1D	0	87.0	0	0
	Control	1F	0	87.0	0	0
	Control	2A	0	NA	NA	NA
	Control	3A	0	NA	NA	NA
	Control	1E	0	75.0	0	0
<u>Blowout 4</u>	8	1A	<1	95.0	0.1	0
	8	1B	1-10	80.6	1.5	2
	8	1C	1-10	86.6	1.0	1
	8	1D	<1	75.6	0	0
	8	1E	1-10	87.4	0.7	1
	8	1F	<1	82.4	0.1	.01
	8	2A	0	NA	NA	NA
	8	3A	0	NA	NA	NA
	8	3B	0	NA	NA	NA

Table 4. Bullet Distribution at Blowouts - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Blowout Number	Range Number	Test Pit Number	Visual Observation at surface (% bullets)	Total Weight of Bullets and Sand (Vol. of 1"x3'x3') (lbs)	Sieved Bullet Weight (lbs)	Weight Percent of Bullets
<u>Blowout 5</u>	1	1A	1-10	97.0	1.0	1
	1	1B	<1	94.0	0.7	1
	1	1C	<1	72.6	0	0
	1	1D	<1	97.4	0.1	.1
	1	1E	0	95.2	0	0
	1	1F	0	86.8	0	0
	1	2A	0	NA	NA	NA

NA Not applicable.

Table 2. Fort Ord Water-Level Data, August 1993 - June 1994
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California

Station Name	Date	Top of Casing Elevation (feet)	Depth to Water (feet)	Water- Level Elevation (feet)	Water in Well (feet)	Comments
PRODUCTION						
MARINA 08	10/26/93	83.50	92.89	(9.39)	317.11	
	12/02/93	83.50	92.98	(9.48)	317.02	
	2/17/94	83.50				not measured
	6/02/94	83.50	93.28	(9.78)	316.72	
MARINA 09	2/17/94	171.49				not measured
	6/02/94	171.49	182.18	(10.69)	405.82	
MW-B-32-180	8/26/93	110.32	122.35	(12.03)	77.65	
	12/03/93	110.32	106.20	4.12	93.80	
	2/17/94	110.32	103.72	6.60	96.28	
	6/02/94	110.32				not measured - not in service

Note:

Elevations are given feet above mean sea level (MSL).

Values in parentheses represent elevations below MSL.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	FO-24	FO-29	FO-30	LUZERN
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9349VBW003F	9349VBW001F	9349VBW002F	9350VBW008F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	12/07/93	12/07/93	12/07/93	12/17/93
Lab Sample Number:	0730330010SA	0730330006SA	0730330008SA	0731850019SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	NA	NA	NA	NA
FUAA-EPA7060					
Arsenic	ug/l	NA	NA	NA	NA
FUAA-EPA7421					
Lead	ug/l	NA	NA	NA	NA
FUAA-EPA7841					
Thallium	ug/l	NA	NA	NA	NA
METALS BY ICP					
Cadmium	ug/l	NA	NA	NA	NA
Calcium	ug/l	40300 VJ4/E	47200 VJ4/E	44300 VJ4/E	66100 AJ4/E
Chromium	ug/l	NA	NA	NA	NA
Copper	ug/l	NA	NA	NA	NA
Iron	ug/l	NA	NA	NA	NA
Magnesium	ug/l	12200 VJ4/E	16300 VJ4/E	12500 VJ4/E	19200 A
Manganese	ug/l	NA	NA	NA	NA
Nickel	ug/l	NA	NA	NA	NA
Potassium	ug/l	2340 V/B	2580 V/B	2500 V/B	3550 A/B
Sodium	ug/l	32900 V	41300 V	30700 V	53500 A
Zinc	ug/l	NA	NA	NA	NA
EPA-150.1					
pH	pH	7.6 V	7.4 V	7.5 V	6.8 A
EPA-300.0					
Sulfate	mg/l	60.7 V/R	70.3 V/R	66.6 V/R	160 A/R
Nitrate as N	mg/l	1.9 V	0.94 V	2.4 V	0.42 AJ3
Chloride	mg/l	49.9 V/R	62 V/R	37.7 V/R	34.9 A/R
Orthophosphate as P	mg/l	NA	NA	NA	NA
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 7. Bullet Distribution in Test Pits - Site 3
Volume II - Remedial Investigation - Basewide RI/FS
Fort Ord, California

Study Area	Test Pit Location	Sample Type	Depth (feet)	Visual Surface Percent of Bullets (%)	Total Weight (lbs)	Bullet Weight (lbs)	Weight Percent of Bullets
<u>Study Area 1</u>	X-2	Surface	0-0.25	1-10	144.4	5.2	3.6
		Encrusted	0.25-1.2		87.6	1.4	1.6
		Below Encrusted	2.5-3.0		50.6	0.01	0.02
	U-6	Surface	0-0.25	>10	69.8	10.8	15.5
		Encrusted	0.33-1.5		53.2	2.4	4.5
		Below Encrusted	2.5-3.0		57.4	0.4	0.7
	O-9	Surface	0-0.25	>10	83.4	8.41	10.1
		Encrusted	0.5-1.5		68.4	0.04	0.06
		Below Encrusted	2.5-3.0		46.0	0.1	0.2
	K-13	Surface	0-0.25	<1	73.0	0.2	0.3
		Encrusted	0.5-1.5		68.4	0.03	0.04
		Below Encrusted	2.5-3.0		45.0	0	0
	M-2	Surface	0-0.25	>10	65.8	7.7	11.7
		Encrusted	0.5-4.0		63.0	1.5	2.4
		Below Encrusted	6.0-6.5		35.2	0.03	0.08
	D-1	Surface	0-0.25	>10	54.6	2.52	4.6
		Encrusted	0.25-0.5		52.0	0.7	1.3
		Below Encrusted	2.0-2.5		33.8	0	0
	K-4	Surface	0-0.25	1-10	61.2	0.22	0.4
		Encrusted	0.42-1.5		38.2	0	0
		Below Encrusted	2.0-2.5		23.4	0	0
	I-9	Surface	0-0.25	0	61.6	0	0
		Encrusted	0.5-1.0		45.6	0	0
		Below Encrusted	2.0-2.5		31.2	0	0
	E-15	Surface	0-0.25	1-10	53.6	0.3	0.6
		Encrusted	0.5-1.0		26.8	0	0
		Below Encrusted	2.0-2.5		32.4	0	0
	C-14	Surface	0-0.25	<1	51.4	0	0
		Encrusted	0.5-1.0		53.8	0	0
		Below Encrusted	2.0-2.5		57.0	0	0

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Sample
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MARINA-02	MARINA-09	MONTEREY SAND CO. -D
Sample Depth(feet):	0.00	0.00	0.00
Sample Number:	9350VBW006F	9350VBW005F	9350JBW091F
Matrix:	H2O	H2O	H2O
Sample Date:	12/15/93	12/15/93	12/15/93
Lab Sample Number:	0731850006SA	0731850004SA	0731850009SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
COLD VAPOR AA							
Mercury	ug/l	NA		NA		NA	
FUAA-EPA7060							
Arsenic	ug/l	NA		NA		NA	
FUAA-EPA7421							
Lead	ug/l	NA		NA		NA	
FUAA-EPA7841							
Thallium	ug/l	NA		NA		NA	
METALS BY ICP							
Cadmium	ug/l	NA		NA		NA	
Calcium	ug/l	59800	AJ4/E	90600	AJ4/E	67800	AJ4/E
Chromium	ug/l	NA		NA		NA	
Copper	ug/l	NA		NA		NA	
Iron	ug/l	NA		NA		NA	
Magnesium	ug/l	23700	A	31800	A	12500	A
Manganese	ug/l	NA		NA		NA	
Nickel	ug/l	NA		NA		NA	
Potassium	ug/l	3350	A/B	4140	A/B	4520	A/B
Sodium	ug/l	83300	A	76800	A	108000	A
Zinc	ug/l	NA		NA		NA	
EPA-150.1							
pH	pH	6.9	A	7.6	A	7.3	A
EPA-300.0							
Sulfate	mg/l	67	A/R	76.3	A/R	38.5	A/R
Nitrate as N	mg/l	23.5	AJ3/R	0.5	AJ3	ND(0.05)	A
Chloride	mg/l	177	A/R	232	A/R	154	A/R
Orthophosphate as P	mg/l	NA		NA		NA	
Bromide	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Report Date: Sep 26, 1994

Table 7. Bullet Distribution in Test Pits - Site 3
Volume II - Remedial Investigation - Basewide RI/FS
Fort Ord, California

Study Area	Test Pit Location	Sample Type	Depth (feet)	Visual Surface Percent of Bullets (%)	Total Weight (lbs)	Bullet Weight (lbs)	Weight Percent of Bullets
<u>Study Area 2</u>	M-38	Surface	0-0.25	1-10	43.2	1.1	2.5
		Encrusted	1.0-1.25		33.2	0.5	1.5
		Below Encrusted	1.25-3.0		48.6	0	0
	S-19	Surface	0-0.25	<1	47.4	0.1	0.002
		Encrusted	0.25-1.5		46.0	0	0
		Below Encrusted	1.5-3.0		44.4	0	0
	M-41	Surface	0-0.25	0	51.2	0	0
		Encrusted	1-1.5		57.2	0	0
		Below Encrusted	1.5-3.0		54.0	0	0

lbs Pounds.

Table 8. Analytical Methods - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Parameter	EPA Test Method	Soil Samples	Leachate Samples
Copper	6010	All	
	7211	If ND by 6010 ^a	
	200.7	--	All
	220.2	--	If ND by 200.7
Zinc	6010	All	--
Lead	6010	All	--
	200.7	--	All
	239.2	--	If ND by 200.7
Iron	6010	All	--
	200.7	--	All
Antimony	6010	All	--
	204.2	--	All
Total Chromium	6010	All	--
	7191	If ND by 6010	--
	218.2	--	All
Chromium VI ^b	7196	All	
Tin	6010	All	--
	282.2	If ND by 6010	--
pH	9045	All	--
	150.1	--	All
Total Organic Carbon	9060	All	--
Cation Exchange Capacity		All	--

ICP Inductively Coupled Plasma.
GFAA Graphite Furnace Atomic Absorption.
ND Not detected.
mg/kg Milligrams per kilogram.
-- Not analyzed.

a If the indicated sample type had an ND result for the metal shown using EPA Test Method 6010 (for soil) or 200.7 (for water), the analysis was repeated using the method shown in the EPA Test Method Column.

b Holding time for hexavalent chromium (CrVI) in soil samples has not been established. However, CrVI is likely to be stable in soil matrices for longer than the 24 hours specified for water samples. Soil samples that were analyzed for CrVI were extracted as soon as possible (72 hours maximum). Once extracted, the aqueous portion was analyzed within the 24-hour holding time specified for water samples.

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Document # BW-12831

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
Basewide Groundwater Monitoring Annual Report
Fort Ord, California
Date Range: 09/14/93 - 06/14/94

Station Number:	MW-01-02-180	MW-01-02-180	MW-01-02-180	MW-01-02-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J01002F	9349J01079F	9408I01015F	9423J01220F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/14/93	12/09/93	02/24/94	06/10/94
Lab Sample Number:	0715830009SA	0730760010SA	0742990017SA	0762350004SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) V/U
FUAA-EPA7060					
Arsenic	ug/l	6.3 A/B	7.8 A/WB	7.1 A/B	7.4 V/B
FUAA-EPA7421					
Lead	ug/l	ND(1.6) A/U	ND(1.6) A/U	ND(1.6) A/U	ND(2.9) V/U
FUAA-EPA7841					
Thallium	ug/l	ND(10) AJ3/NWU	ND(10) A/U	ND(2) AJ3/NWU	ND(10.5) VR2J3/NWU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	4.6 A/B	ND(4.3) A/U	ND(4.3) V/U
Calcium	ug/l	NA	NA	NA	NA
Chromium	ug/l	5 A/B	ND(4.7) A/U	ND(4.7) A/U	ND(3.6) V/U
Copper	ug/l	ND(4) A/U	ND(5.1) AU1/B	ND(4) A/U	2.6 V/B
Iron	ug/l	NA	NA	NA	NA
Magnesium	ug/l	NA	NA	NA	NA
Manganese	ug/l	NA	NA	NA	NA
Nickel	ug/l	ND(27) A/U	ND(27) A/U	ND(27) A/U	ND(24) V/U
Potassium	ug/l	NA	NA	NA	NA
Sodium	ug/l	NA	137000 A	NA	NA
Zinc	ug/l	ND(7.1) AU2/B	ND(2.8) AU1/B	ND(107) AU1	ND(11.6) VU1/B
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	NA	NA
Nitrate as N	mg/l	4.7 A	22.5 A/R	4.7 A	4.4 V/R
Chloride	mg/l	NA	NA	NA	NA
Orthophosphate as P	mg/l	0.97 A	1.6 AJ3	0.81 A	0.85 V
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-01-02-180	MW-01-02-180	MW-01-02-180	MW-01-02-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J01002F	9349J01079F	9408I01015F	9423J01220F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/14/93	12/09/93	02/24/94	06/10/94
Lab Sample Number:	0715830009SA	0730760010SA	0742990017SA	0762350004SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	
EPA-7041							
Antimony	ug/l	6.7 A/B		4 A/B		2.2 A/B	
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-01-03-180	MW-01-03-180	MW-01-03-180	MW-01-03-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J01004F	9349J01080F	9408J01017F	9423J01221F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/14/93	12/09/93	02/24/94	06/10/94
Lab Sample Number:	0715830011SA	0730760011SA	0742990019SA	0762350005SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) V/U
FUAA-EPA7060					
Arsenic	ug/l	2.4 A/B	2.8 A/WB	ND(2.5) A/WU	ND(2.5) V/WU
FUAA-EPA7421					
Lead	ug/l	ND(1.6) A/U	ND(1.6) A/WU	ND(1.6) A/U	ND(2.9) V/U
FUAA-EPA7841					
Thallium	ug/l	ND(10) AJ3/NWU	ND(10) A/WU	ND(2) AJ3/NWU	ND(2.1) VR2J3/NWU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) V/U
Calcium	ug/l	NA	NA	NA	NA
Chromium	ug/l	ND(4.7) A/U	ND(4.7) A/U	ND(4.7) A/U	ND(3.6) V/U
Copper	ug/l	ND(4) A/U	ND(4.9) AU1/B	ND(4) A/U	ND(1.8) V/U
Iron	ug/l	NA	NA	NA	NA
Magnesium	ug/l	NA	NA	NA	NA
Manganese	ug/l	NA	NA	NA	NA
Nickel	ug/l	ND(27) A/U	ND(27) A/U	ND(27) A/U	ND(24) V/U
Potassium	ug/l	NA	NA	NA	NA
Sodium	ug/l	NA	80900 A	NA	NA
Zinc	ug/l	ND(13.7) AU2/B	ND(4) AU1/B	ND(155) AU1	ND(3.2) VU1/B
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	NA	NA
Nitrate as N	mg/l	4.2 A	8.8 A/R	6.6 A/R	4.7 V
Chloride	mg/l	NA	NA	NA	NA
Orthophosphate as P	mg/l	ND(0.2) A	ND(0.2) A	ND(0.2) A	ND(0.2) V
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-01-03-180	MW-01-03-180	MW-01-03-180	MW-01-03-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J01004F	9349J01080F	9408I01017F	9423J01221F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/14/93	12/09/93	02/24/94	06/10/94
Lab Sample Number:	0715830011SA	0730760011SA	0742990019SA	0762350005SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	
EPA-7041							
Antimony	ug/l	4.1 A/WB		8.2 A/B		4.5 A/B	ND(2.2) V/WU
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

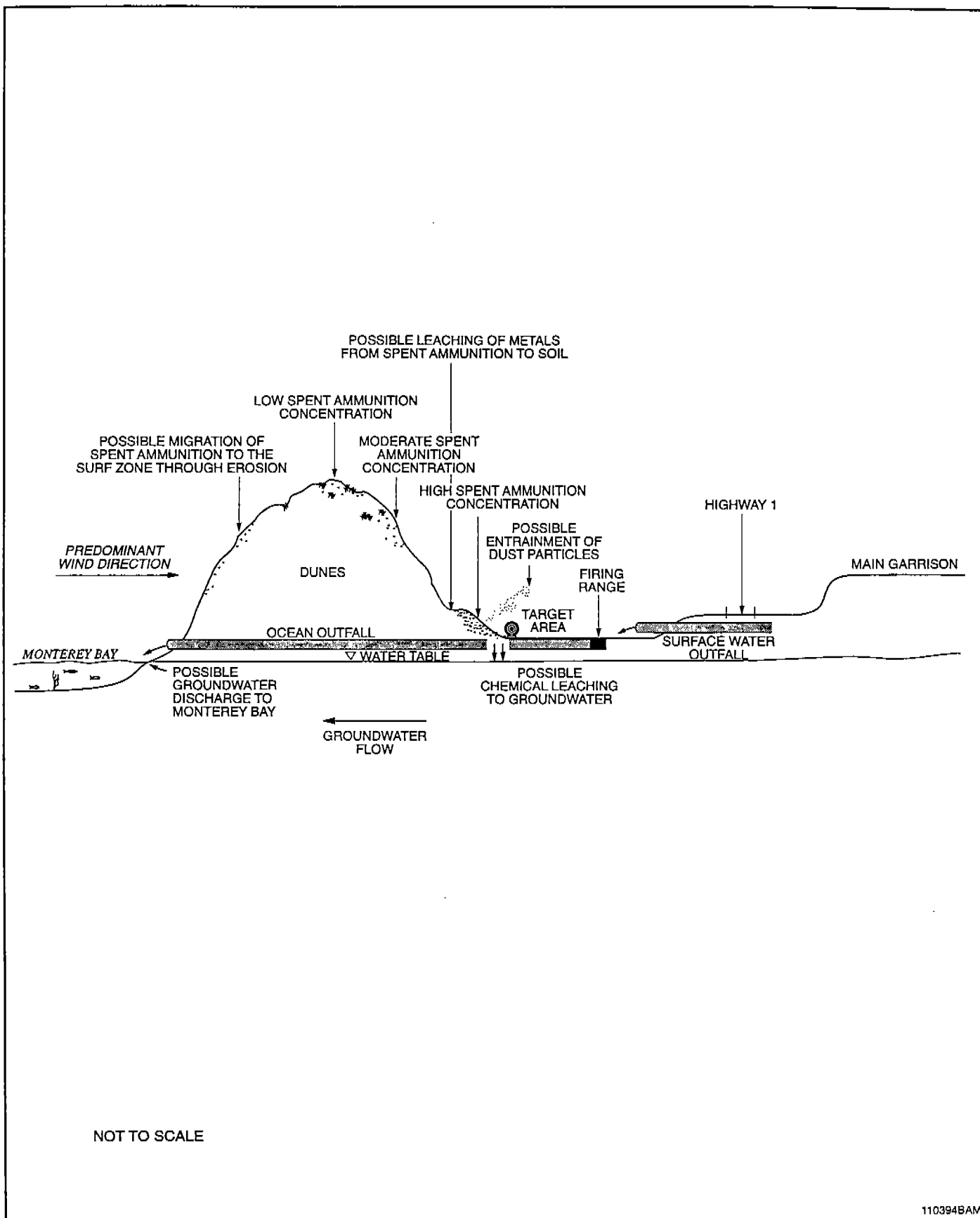
NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

PLATES

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Document # BW-12831



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Harding Lawson Associates
Engineering and
Environmental Services

**Conceptual Model of Potential
Migration Pathways - Site 3**
Volume II - RI, Basewide RI/FS
Fort Ord, California

PLATE

6

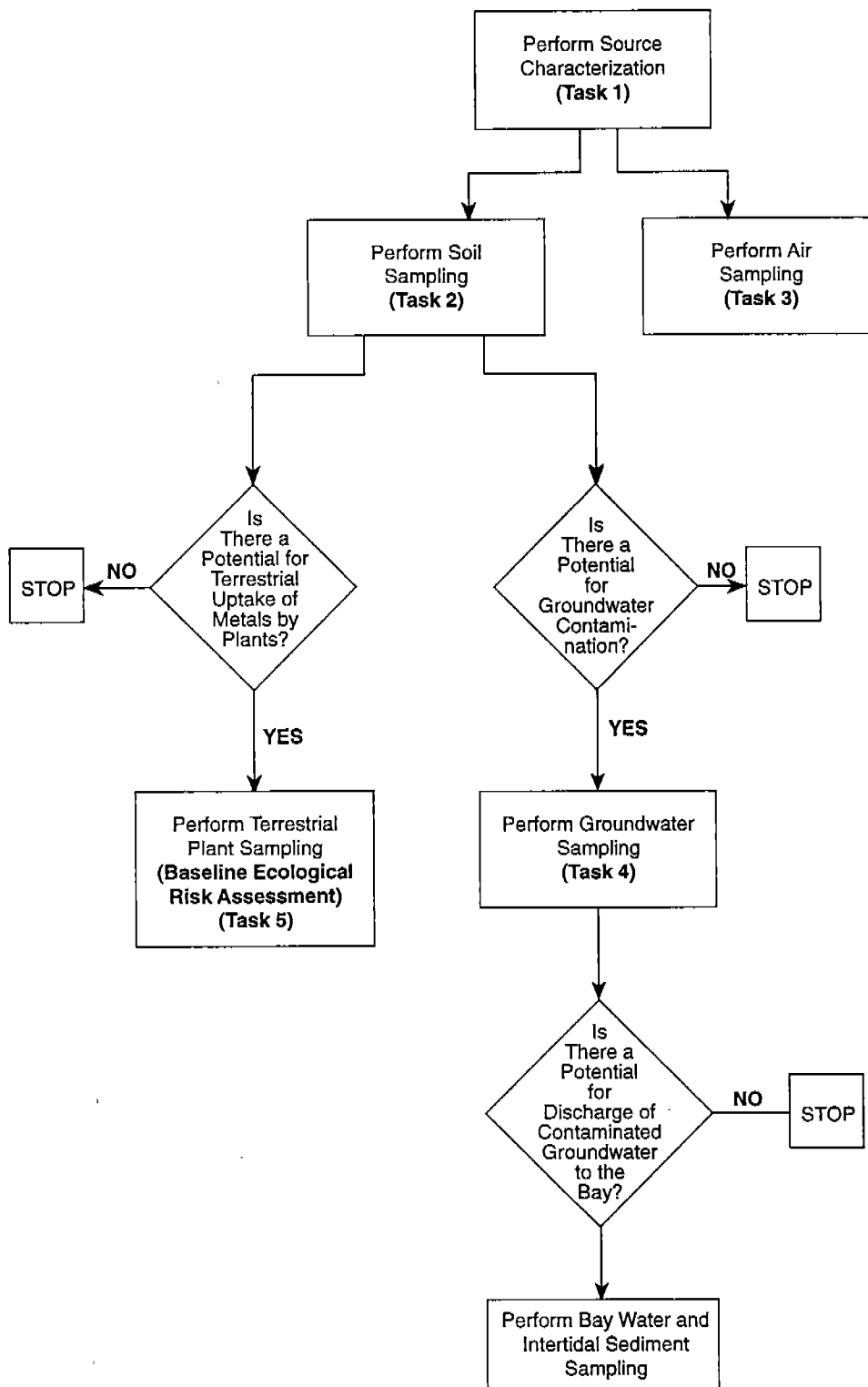
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JOB NUMBER
23366 041721

APPROVED
MLW

DATE
6/94

REVISED DATE
11/94



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Harding Lawson Associates

Engineering and
Environmental Services

Decision Tree For Field Activities - Site 3

Volume II - RI, Basewide RI/FS

Fort Ord, California

PLATE

7

DRAWN
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23366 041721

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11/94

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Document # BW-1283 I



Example Photo of Surface at Range 12



Example Photo of Shallow Excavation at Range 8

080394SE



Harding Lawson Associates
Engineering and
Environmental Services

**Representative Photographs of the Vertical
Distribution of Spent Ammunition - Site 3**
Volume II - RI, Basewide RI/FS
Fort Ord, California

PLATE

10

DRAWN
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23366 0417 21

APPROVED
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6/94

REVISED DATE
11/94

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Document # BW-1283 I

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-02-04-180	MW-02-04-180	MW-02-04-180	MW-02-04-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9402C002011F	9408I02006F	9413J02193F	9423I02041F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	01/13/94	02/23/94	03/30/94	06/07/94
Lab Sample Number:	0735230017SA	0743010011SA	0748370013SA	0761420010SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
COLD VAPOR AA							
Mercury	ug/l	ND(0.2)	A/U	ND(0.2)	V/U	ND(0.2)	A/U
FUAA-EPA7060							
Arsenic	ug/l	ND(2.5)	A/U	ND(2.5)	V/U	ND(2.5)	A/U
FUAA-EPA7421							
Lead	ug/l	ND(2.9)	A/U	ND(2.9)	V/U	ND(2.9)	A/U
FUAA-EPA7841							
Thallium	ug/l	ND(2.1)	A/WU	ND(2.1)	VJ3/NWU	ND(2.1)	AJ3/NWU
METALS BY ICP							
Cadmium	ug/l	ND(4.3)	A/U	ND(4.3)	V/U	ND(4.3)	A/U
Calcium	ug/l	16100	A	NA		NA	
Chromium	ug/l	ND(3.6)	A/U	ND(3.6)	V/U	ND(3.6)	A/U
Copper	ug/l	ND(1.8)	A/U	ND(4)	VU1/B	ND(1.8)	A/U
Iron	ug/l	37	A/B	NA		NA	
Magnesium	ug/l	14300	A	NA		NA	
Manganese	ug/l	6.8	A/B	NA		NA	
Nickel	ug/l	ND(24)	A/U	ND(24)	V/U	ND(24)	A/U
Potassium	ug/l	2080	A/B	NA		NA	
Sodium	ug/l	61300	A	NA		NA	
Zinc	ug/l	21.3	A	ND(18)	VU2/B	ND(10.7)	AU1/B
EPA-150.1							
pH	pH	NA		NA		NA	
EPA-300.0							
Sulfate	mg/l	30.7	A	NA		NA	
Nitrate as N	mg/l	5.4	A/R	5.1	V/R	NA	6.5 A/R
Chloride	mg/l	82.7	A/R	NA		NA	
Orthophosphate as P	mg/l	ND(0.2)	A	ND(0.2)	V	NA	ND(0.2) A
Bromide	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

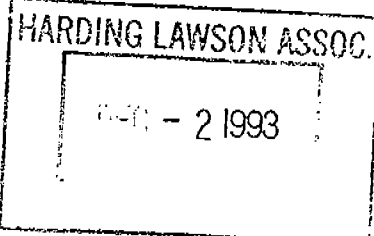
NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

APPENDIX A
ANALYSES BY X-RAY FLUORESCENCE

EA'

NORTHERN CALIFORNIA
ANALYTICAL LABORATORIES
P.O. BOX 23
350 RHEEM BLVD, SUITE 8
MORAGA, CALIFORNIA 94556
(510) 378-7010



NOV. 26. 1993

ENERGY-DISPERSIVE X-RAY ANALYSIS

T003002F

STARTING DATA

I	Z	TYPE	SOURCE	CALIB.CONST.	SEC	MON.CTS.	WT.FRAC.	COUNTS
1	CU	KA	3	4160000.000	100	3338		328000.
2	PB	LA	3	1569920.000	100	3338		1070.
3	FE	KA	3	3200000.000	100	3338		573.
4	ZN	KA	3	4359680.000	100	3338		41250.

CALCULATED RESULTS

ELEMENT	WEIGHT PERCENT	STD. DEV.
CU	90.56	0.00
PB	0.80	0.00
FE	0.15	0.00
ZN	8.49	0.00

ENTER C, S, SD.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-02-05-180	MW-02-05-180	MW-02-05-180	MW-02-05-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337X02004F	9402C002015F	9408I02007F	9412D002258F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/15/93	01/13/94	02/23/94	03/25/94
Lab Sample Number:	0716050009SA	0735230018SA	0743010012SA	0748370009SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
EPA-160.1					
Total Dissolved Solids	mg/l	NA	364 A	NA	NA
EPA-160.2					
Total Suspended Solids	mg/l	NA	281 A	NA	NA
EPA-120.1					
Specific Conductance at 25 deg. C	umhos	NA	NA	NA	NA
EPA-INORGANICS					
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA	92.8 A	NA	NA
Alkalinity, Total (as CaCO3)	mg/l	NA	92.8 A	NA	NA
EPA-7041					
Antimony	ug/l	9.2 A/WB	3.5 A/WB	ND(5.6) VU2/B	6.6 A/WB
SM314A					
Hardness (as CaCO3)	mg/l	NA	142 A	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Sample
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-02-05-180	MW-02-06-180	MW-02-06-180
Sample Depth(feet):	0.00	0.00	0.00
Sample Number:	9423102042F	9337X02006F	9403D002012F
Matrix:	H2O	H2O	H2O
Sample Date:	06/07/94	09/15/93	01/17/94
Lab Sample Number:	0761420011SA	0716050011SA	0735970008SA

Test Method/Analyte Name	Units	value qual	value qual	value qual
COLD VAPOR AA				
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U
FUAA-EPA7060				
Arsenic	ug/l	ND(2.5) A/U	4 A/B	5.3 A/WB
FUAA-EPA7421				
Lead	ug/l	ND(2.9) A/U	ND(1.6) A/U	ND(2.9) A/U
FUAA-EPA7841				
Thallium	ug/l	ND(10.5) AJ3/NU	ND(2) AJ3/NWU	ND(2.1) AJ3/NWU
METALS BY ICP				
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) A/U
Calcium	ug/l	NA	NA	15700 A/E
Chromium	ug/l	ND(4.7) A/U	ND(4.7) A/U	ND(3.6) A/U
Copper	ug/l	ND(4.6) AU1/B	ND(4) A/U	ND(1.8) A/U
Iron	ug/l	NA	NA	2340 A
Magnesium	ug/l	NA	NA	12800 A
Manganese	ug/l	NA	NA	27.1 A
Nickel	ug/l	ND(27) A/U	ND(27) A/U	ND(24) A/U
Potassium	ug/l	NA	NA	1890 A/B
Sodium	ug/l	NA	NA	72900 A
Zinc	ug/l	39.8 A	31 A	ND(19.8) AU1/B
EPA-150.1				
pH	pH	NA	NA	NA
EPA-300.0				
Sulfate	mg/l	NA	NA	49.8 A/R
Nitrate as N	mg/l	8.3 A/R	2.8 A	3.3 A
Chloride	mg/l	NA	NA	69.7 A/R
Orthophosphate as P	mg/l	ND(0.2) A	ND(0.2) A	ND(0.2) A
Bromide	mg/l	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picroCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Report Date: Sep 26, 1994

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NOV. 26, 1993

ENERGY-DISPERSIVE X-RAY ANALYSIS

T003005F

STARTING DATA

I	Z	TYPE	SOURCE	CALIB.CONST.	SEC	MON.CTS	WT.FRAC.	COUNTS
1	SN	KA	5	1200000.000	100	3996		73.
2	SB	KA	5	1149760.000	100	3996		69.
3	CU	KA	3	4160000.000	100	3338		464900.
4	PB	LA	3	1569920.000	100	3338		5815.
5	FE	KA	3	3200000.000	100	3338		1560.
6	ZN	KA	3	4359680.000	100	3338		58670.

CALCULATED RESULTS

ELEMENT	WEIGHT PERCENT	STD. DEV.
SN	234 *	0
SB	212 *	0
CU	87.99	0.00
PB	2.95	0.00
FE	0.32	0.00
ZN	8.69	0.00

* - PPM

ENTER C, S, SO, A, CL, LI, SE, DE, OR

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NOV. 26, 1993

ENERGY-DISPERSIVE X-RAY ANALYSIS

T003006F

STARTING DATA

I	Z	TYPE	SOURCE	CALIB.CONST.	SEC	MON.CTS.	WT.FRAC.	COUNTS
1	AG	KA	5	1369600.000	100	3996		44.
2	SB	KA	5	1149760.000	100	3996		80.
3	PB	LA	3	1569920.000	100	3338		6302.
4	CU	KA	3	4160000.000	100	3338		415100.
5	FE	KA	3	3200000.000	100	3338		1122.
6	ZN	KA	3	4359680.000	100	3338		51490.

CALCULATED RESULTS

ELEMENT	WEIGHT PERCENT	STD. DEV.
AG	229 *	0
SB	277 *	0
PB	3.47	0.00
CU	88.14	0.00
FE	0.25	0.00
ZN	8.10	0.00

* - PPM

ENTER C, S, SO, A, CL

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Sam
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-02-06-180	MW-02-06-180	MW-02-07-180
Sample Depth(feet):	0.00	0.00	0.00
Sample Number:	9413J02195F	9423I02043F	9337X02012F
Matrix:	H2O	H2O	H2O
Sample Date:	03/30/94	06/07/94	09/16/93
Lab Sample Number:	0748370015SA	0761420012SA	0716050019SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	
EPA-7041							
Antimony	ug/l	7.3	A/B	2.7	A/B	2.8	A/WB
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses

Report Date: Sep 26, 199

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Sampling
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-02-07-180	MW-02-07-180	MW-02-07-180
Sample Depth(feet):	0.00	0.00	0.00
Sample Number:	9402C002018F	9408J02106F	9412D002253F
Matrix:	H2O	H2O	H2O
Sample Date:	01/13/94	02/24/94	03/24/94
Lab Sample Number:	0735230020SA	0743450004SA	0748370004SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
COLD VAPOR AA							
Mercury	ug/l	0.55	A	0.71	A	0.92	A
FUAA-EPA7060							
Arsenic	ug/l	ND(2.5)	A/WU	ND(2.5)	A/U	ND(2.5)	A/U
FUAA-EPA7421							
Lead	ug/l	ND(2.9)	A/WU	ND(2.9)	A/WU	ND(14.5)	A/WU
FUAA-EPA7841							
Thallium	ug/l	ND(10.5)	A/WU	ND(21)	AJ3/NWU	ND(21)	AJ3/NU
METALS BY ICP							
Cadmium	ug/l	ND(4.3)	A/U	ND(4.3)	A/U	ND(4.3)	A/U
Calcium	ug/l	756000	A	NA		NA	
Chromium	ug/l	ND(3.6)	A/U	ND(3.6)	A/U	ND(3.6)	A/U
Copper	ug/l	ND(23.6)	AU1/B	ND(16.6)	AU1/B	ND(22)	AU1/B
Iron	ug/l	51.9	A/B	NA		NA	
Magnesium	ug/l	1200000	A	NA		NA	
Manganese	ug/l	297	A	NA		NA	
Nickel	ug/l	ND(24)	A/U	ND(24)	A/U	ND(24)	A/U
Potassium	ug/l	47000	A	NA		NA	
Sodium	ug/l	7080000	A	NA		NA	
Zinc	ug/l	331	A	86.9	A	124	A
EPA-150.1							
pH	pH	NA		NA		NA	
EPA-300.0							
Sulfate	mg/l	1800	A/R	NA		NA	
Nitrate as N	mg/l	ND(5)	A/G	ND(5)	A/G	NA	
Chloride	mg/l	12000	A/R	NA		NA	
Orthophosphate as P	mg/l	ND(20)	A/G	ND(20)	A/G	NA	
Bromide	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Report Date: Sep 26, 1994

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NOV. 26, 1993

ENERGY-DISPERSIVE X-RAY ANALYSIS

T003009F

STARTING DATA

I	Z	TYPE	SOURCE	CALIB.CONST.	SEC	MON.CTS.	WT.FRAC.	COUNTS
1	CD	KA	5	1249920.000	100	3996		46.
2	SN	KA	5	1200000.000	100	3996		892.
3	SB	KA	5	1149760.000	100	3996		16600.
4	FE	KA	3	3200000.000	100	3338		678.
5	CU	KA	3	4160000.000	100	3338		528.
6	PB	LA	3	1569920.000	100	3338		188100.
7	ZN	KA	3	4359680.000	100	3338		215.

CALCULATED RESULTS

ELEMENT	WEIGHT PERCENT	STD. DEV.
CD	528 *	0
SN	0.77	0.00
SB	13.62	0.00
FE	0.95	0.00
CU	0.25	0.00
PB	84.28	0.00
ZN	734 *	0

* - PPM

ENTER C, S, SO, A, C

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NOV. 26, 1993

ENERGY-DISPERSIVE X-RAY ANALYSIS

T0030010F

STARTING DATA

I	Z	TYPE	SOURCE	CALIB.	CONST.	SEC	MON.CTS.	WT.FRAC.	COUNTS
1	AG	KA	5	1369600.	000	100	3996		25.
2	CD	KA	5	1249920.	000	100	3994		15.
3	SN	KA	5	1200000.	000	100	3996		58.
4	SB	KA	5	1149760.	000	100	3994		233.
5	CU	KA	3	4160000.	000	100	3338	320100.	
6	PB	LA	3	1569920.	000	100	3338	11510.	
7	FE	KA	3	3200000.	000	100	3338	674.	
8	ZN	KA	3	4359680.	000	100	3338	42420.	

CALCULATED RESULTS

ELEMENT	WEIGHT PERCENT	STD. DEV.
AG	157 *	0
CD	90 *	0
SN	255 *	0
SB	989 *	0
CU	84.32	0.01
PB	7.09	0.00
FE	0.20	0.00
ZN	8.24	0.00

* - PPM

25 0

CALCULATED RESULTS		
ELEMENT	WEIGHT PERCENT	STD. DEV.
SB	336 *	20
BA	386 *	30
LA	194 *	37
CE	320 *	50
FE	17.11	0.03
CU	0.29	0.01
SR	228 *	5
PB	0.54	0.00
ZN	423 *	29
RB	25 *	4
ZR	0.13	0.00
NB	27 *	2
CR	0.14	0.00
NI	64 *	9
MN	0.13	0.00
SI	29.20	0.15
S	0.16	0.02
CL	894 *	108
K	1.09	0.01
TI	0.76	0.00
CA	2.17	0.01
AL	3.90	0.11
NA	0.98	0.62
MG	0.53	0.15

* - PPM

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NOV. 30. 1993

ENERGY-DISPERSIVE X-RAY ANALYSIS

T0030011F (*outer crust*)

STARTING DATA

I	Z	TYPE	SOURCE	CALIB.	CONST.	SEC	MON.CTS.	WT.FRAC.	COUNTS
1	SB	KA	5	1149760.00	300	3979	925.		
2	BA	KA	5	739840.00	300	3979	1507.		
3	LA	KA	5	649920.00	300	3979	690.		
4	CE	KA	5	520000.00	300	3979	945.		
5	FE	KA	3	3200000.00	200	3287	130769.		
6	CU	KA	3	4160000.00	200	3287	3550.		
7	SR	KA	3	6599680.00	200	3287	3311.		
8	PB	LA	3	1569920.00	200	3287	12697.		
9	ZN	KA	3	4359680.00	200	3287	716.		
10	RB	KA	3	6197760.00	200	3287	273.		
11	ZR	KA	3	7144960.00	200	3287	28728.		
12	NB	KA	3	7398400.00	200	3287	684.		
13	CR	KA	2	800000.00	200	3403	1350.		
14	NI	KA	2	1289920.00	200	3403	133.		
15	MN	KA	2	1000000.00	200	3403	1731.		
16	SI	KA	4	1649920.00	200	357	38513.		
17	S	KA	4	2739200.00	200	357	570.		
18	CL	KA	4	3349760.00	200	357	616.		
19	K	KA	4	5299200.00	200	357	29475.		
20	TI	KA	4	8499200.00	200	357	70494.		
21	CA	KA	4	5798400.00	200	357	95838.		
22	AL	KA	1	364960.00	200	152	2283.		
23	NA	KA	1	60000.00	200	152	31.		
24	MG	KA	1	190000.00	200	152	97.		

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NOV. 30. 1993

ENERGY-DISPERSIVE X-RAY ANALYSIS

T003012F

STARTING DATA

I	Z	TYPE	SOURCE	CALIB.CONST.	SEC	MON.CTS.	WT.FRAC.	COUNTS
1	BA	KA	5	739840.00	200	3979		2859.
2	FE	KA	3	3200000.00	300	3287		4922.
3	RB	KA	3	6197760.00	300	3287		2648.
4	SR	KA	3	6599680.00	300	3287		11023.
5	PB	LA	3	1569920.00	300	3287		187.
6	Y	KA	3	6097920.00	300	3287		467.
7	ZR	KA	3	7144960.00	300	3287		4537.
8	GA	KA	2	1449600.00	400	3403		144.
9	MN	KA	2	1000000.00	400	3403		189.
10	SI	KA	4	1649920.00	300	357		107105.
11	K	KA	4	5299200.00	300	357		89100.
12	TI	KA	4	8499200.00	300	357		3590.
13	CA	KA	4	5798400.00	300	357		35666.
14	NA	KA	1	60000.00	400	152		205.
15	AL	KA	1	364960.00	400	152		4686.

16 0

CALCULATED RESULTS

ELEMENT	WEIGHT PERCENT	STD. DEV.
BA	876 *	36
FE	0.37	0.01
RB	61 *	2
SR	195 *	2
PB	20 *	6
Y	7 *	1
ZR	57 *	1
GA	6 *	1
MN	55 *	6
SI	38.61	0.12
K	2.15	0.01
TI	238 *	8
CA	0.54	0.00
NA	2.27	0.50
AL	3.20	0.06

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-02-10-180	MW-02-10-180	MW-02-10-180	MW-02-10-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9403D002015F	9408J02109F	9412D002257F	9423I02047F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	01/17/94	02/24/94	03/25/94	06/08/94
Lab Sample Number:	0735970011SA	0743450008SA	0748370007SA	0762030004SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) A/WU	ND(2.5) A/U	ND(2.5) A/U	ND(2.5) A/WU
FUAA-EPA7421					
Lead	ug/l	ND(2.9) A/U	ND(2.9) A/U	ND(2.9) A/U	ND(2.9) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(2.1) AJ3/NU	ND(2.1) AJ3/NWU	ND(10.5) AJ3/NU	ND(2.1) AJ3/NWU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) A/U
Calcium	ug/l	17600 A/E	NA	NA	NA
Chromium	ug/l	ND(3.6) A/U	ND(3.6) A/U	ND(3.6) A/U	ND(3.6) A/U
Copper	ug/l	ND(21.9) AU1/B	ND(6.7) AU1/B	ND(1.8) A/U	3.3 A/B
Iron	ug/l	ND(20.8) AU1/B	NA	NA	NA
Magnesium	ug/l	16100 A	NA	NA	NA
Manganese	ug/l	51.3 A	NA	NA	NA
Nickel	ug/l	ND(24) A/U	ND(24) A/U	ND(24) A/U	ND(24) A/U
Potassium	ug/l	3680 A/B	NA	NA	NA
Sodium	ug/l	71000 A	NA	NA	NA
Zinc	ug/l	123 A	13.9 A/B	23.4 A	43.5 A
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	24.2 A	NA	NA	NA
Nitrate as N	mg/l	17 A/R	15.5 A/R	NA	14.8 A/R
Chloride	mg/l	72.9 A/R	NA	NA	NA
Orthophosphate as P	mg/l	ND(0.2) A	ND(0.2) A	NA	ND(0.2) A
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picroCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Sampling
Basewide Groundwater Monitoring Annual Report
Fort Ord, California
Date Range: 09/14/93 - 06/14/94

Station Number:	MW-02-10-180	MW-02-10-180	MW-02-10-180
Sample Depth(feet):	0.00	0.00	0.00
Sample Number:	9403D002015F	9408J02109F	9412D002257F
Matrix:	H2O	H2O	H2O
Sample Date:	01/17/94	02/24/94	03/25/94
Lab Sample Number:	0735970011SA	0743450008SA	0748370007SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	350	A	NA		NA	
EPA-160.2							
Total Suspended Solids	mg/l	101	A	NA		NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	51.2	A	NA		NA	
Alkalinity, Total (as CaCO3)	mg/l	51.2	A	NA		NA	
EPA-7041							
Antimony	ug/l	ND(4.8)	AU2/B	ND(2.2)	A/WU	ND(2.2)	A/WU
SM314A							
Hardness (as CaCO3)	mg/l	110	A	NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses

Report Date: Sep 26, 199

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-01-180	MW-12-01-180	MW-12-01-180	MW-12-01-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J12005F	9402C012005F	9408J12094F	9412D012248F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/15/93	01/11/94	02/22/94	03/23/94
Lab Sample Number:	0716050003SA	0735230008SA	0743010001SA	0747920017SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) V/U	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.4) A/U	ND(2.5) A/U	ND(2.5) V/U	ND(2.5) A/U
FUAA-EPA7421					
Lead	ug/l	ND(1.6) A/U	ND(2.9) A/U	ND(2.9) VJ3/U	ND(2.9) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(10) AJ3/NU	ND(2.1) A/WU	ND(10.5) VJ3/NU	ND(21) A/EU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) V/U	ND(4.3) A/U
Calcium	ug/l	NA	37500 A	NA	NA
Chromium	ug/l	ND(4.7) A/U	ND(3.6) A/U	16.2 V	ND(3.7) AU2/B
Copper	ug/l	11.7 A/B	ND(7.8) AU1/B	6.7 V/B	ND(1.8) A/U
Iron	ug/l	NA	39.1 A/B	NA	NA
Magnesium	ug/l	NA	25900 A	NA	NA
Manganese	ug/l	NA	11 A/B	NA	NA
Nickel	ug/l	ND(48.6) AU1	ND(24) A/U	35.6 V/B	ND(69.1) AU2
Potassium	ug/l	NA	2070 A/B	NA	NA
Sodium	ug/l	NA	57500 A	NA	NA
Zinc	ug/l	ND(9.4) AU1/B	ND(18.4) AU1/B	ND(25.5) VU2	ND(16.6) AU2/B
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	50.4 A/R	NA	NA
Nitrate as N	mg/l	7.4 A/R	8.1 A/R	7.7 V/R	NA
Chloride	mg/l	NA	98.7 A/R	NA	NA
Orthophosphate as P	mg/l	ND(0.2) A	ND(0.2) A	ND(0.2) V	NA
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-01-180	MW-12-01-180	MW-12-01-180	MW-12-01-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J12005F	9402C012005F	9408J12094F	9412D012248F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/15/93	01/11/94	02/22/94	03/23/94
Lab Sample Number:	0716050003SA	0735230008SA	0743010001SA	0747920017SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		435	A	NA	
EPA-160.2							
Total Suspended Solids	mg/l	NA		25	A	NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		95.5	A	NA	
Alkalinity, Total (as CaCO3)	mg/l	NA		95.5	A	NA	
EPA-7041							
Antimony	ug/l	5.4	A/WB	2.1	A/WB	ND(2.2)	V/U
SM314A							
Hardness (as CaCO3)	mg/l	NA		200	A	NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-01-180	MW-12-02-180	MW-12-02-180	MW-12-02-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9423J12192F	9337J12006F	9402C012006F	9408J12095F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	06/06/94	09/15/93	01/11/94	02/22/94
Lab Sample Number:	0761420007SA	0716050004SA	0735230009SA	0743010003SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) V/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) A/U	ND(2.4) A/U	ND(2.5) A/U	ND(2.5) V/U
FUAA-EPA7421					
Lead	ug/l	ND(2.9) A/U	ND(1.6) A/U	ND(2.9) A/U	ND(2.9) V/U
FUAA-EPA7841					
Thallium	ug/l	ND(10.5) AJ3/NWU	ND(2) AJ3/NWU	ND(2.1) A/U	ND(10.5) VJ3/NWU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) V/U
Calcium	ug/l	NA	NA	14100 A	NA
Chromium	ug/l	6.1 A/B	ND(4.7) A/U	ND(3.6) A/U	5.3 V/B
Copper	ug/l	ND(4) A/U	ND(4) A/U	ND(3) AU1/B	ND(6.1) VU1/B
Iron	ug/l	NA	NA	40.4 A/B	NA
Magnesium	ug/l	NA	NA	9240 A	NA
Manganese	ug/l	NA	NA	8.6 A/B	NA
Nickel	ug/l	54.4 A	ND(30.5) AU1/B	25.5 A/B	ND(24) V/U
Potassium	ug/l	NA	NA	1690 A/B	NA
Sodium	ug/l	NA	NA	42700 A	NA
Zinc	ug/l	ND(22.5) AU2	ND(10.9) AU1/B	23.1 A	ND(23.3) VU2
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	22.6 A	NA
Nitrate as N	mg/l	5.7 A/R	4.7 A	4.5 A/R	11.3 V/R
Chloride	mg/l	NA	NA	40.1 A/R	NA
Orthophosphate as P	mg/l	ND(0.2) A	0.4 A	0.35 A	0.24 V
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picroCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-01-180	MW-12-02-180	MW-12-02-180	MW-12-02-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9423J12192F	9337J12006F	9402C012006F	9408J12095F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	06/06/94	09/15/93	01/11/94	02/22/94
Lab Sample Number:	0761420007SA	0716050004SA	0735230009SA	0743010003SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		227 A	NA
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		44 A	NA
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	NA
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		63.8 A	NA
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		63.8 A	NA
EPA-7041							
Antimony	ug/l	7.6 A/WB		3.9 A/B		10.1 A	ND(2.2) V/U
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		73.2 A	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-02-180	MW-12-02-180	MW-12-03-180	MW-12-03-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9412D012241F	9423J12193F	9337J12007F	9402C012001F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	03/22/94	06/06/94	09/15/93	01/10/94
Lab Sample Number:	0747920009SA	0761420008SA	0716050006SA	0735230001SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
COLD VAPOR AA							
Mercury	ug/l	ND(0.2)	A/U	ND(0.2)	A/U	ND(0.2)	A/U
FUAA-EPA7060							
Arsenic	ug/l	ND(2.5)	A/WU	ND(2.5)	A/U	ND(2.4)	A/U
FUAA-EPA7421							
Lead	ug/l	ND(2.9)	A/U	ND(2.9)	A/U	ND(1.6)	A/U
FUAA-EPA7841							
Thallium	ug/l	ND(2.1)	A/WU	ND(10.5)	AJ3/NWU	ND(2)	AJ3/NWU
METALS BY ICP							
Cadmium	ug/l	ND(4.3)	A/U	ND(4.3)	A/U	ND(4.3)	A/U
Calcium	ug/l	NA		NA		NA	42800 A
Chromium	ug/l	ND(3.6)	A/U	ND(4.7)	A/U	ND(4.7)	A/U
Copper	ug/l	ND(1.8)	A/U	ND(4)	A/U	ND(4)	A/U
Iron	ug/l	NA		NA		NA	138 A
Magnesium	ug/l	NA		NA		NA	28000 A
Manganese	ug/l	NA		NA		NA	81 A
Nickel	ug/l	ND(24)	A/U	ND(27)	A/U	ND(27)	A/U
Potassium	ug/l	NA		NA		NA	2810 A/B
Sodium	ug/l	NA		NA		NA	69500 A
Zinc	ug/l	ND(7.6)	AU2/B	32.6	A	ND(9.1)	AU1/B
EPA-150.1							
pH	pH	NA		NA		NA	
EPA-300.0							
Sulfate	mg/l	NA		NA		NA	45.7 A/R
Nitrate as N	mg/l	NA		8.9	A/R	5.3	A/R
Chloride	mg/l	NA		NA		NA	134 A/R
Orthophosphate as P	mg/l	NA		ND(0.2)	A	ND(0.2)	A
Bromide	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-02-180	MW-12-02-180	MW-12-03-180	MW-12-03-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9412D012241F	9423J12193F	9337J12007F	9402C012001F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	03/22/94	06/06/94	09/15/93	01/10/94
Lab Sample Number:	0747920009SA	0761420008SA	0716050006SA	0735230001SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual	value	qual
EPA-160.1									
Total Dissolved Solids	mg/l	NA		NA		NA		481	A
EPA-160.2									
Total Suspended Solids	mg/l	NA		NA		NA		73	A
EPA-120.1									
Specific Conductance at 25 deg. C	umhos	NA		NA		NA		NA	
EPA-INORGANICS									
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA		97.3	A
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA		97.3	A
EPA-7041									
Antimony	ug/l	ND(2.2)	A/WU	6.4	A/WB	5.6	A/B	3.4	A/B
SM314A									
Hardness (as CaCO3)	mg/l	NA		NA		NA		222	A

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-03-180	MW-12-03-180	MW-12-03-180	MW-12-04-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J12096F	9412D012244F	9423J12194F	9337J12011F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/22/94	03/23/94	06/06/94	09/16/93
Lab Sample Number:	0743010004SA	0747920012SA	0761420009SA	0716270008SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
COLD VAPOR AA							
Mercury	ug/l	ND(0.2)	V/U	ND(0.2)	A/U	ND(0.2)	A/U
FUAA-EPA7060							
Arsenic	ug/l	ND(2.5)	V/U	ND(2.5)	A/WU	ND(2.5)	A/WU
FUAA-EPA7421							
Lead	ug/l	ND(2.9)	V/U	ND(2.9)	A/U	5.7	A/W
FUAA-EPA7841							
Thallium	ug/l	ND(10.5)	VJ3/NWU	ND(21)	A/EU	ND(10.5)	AJ3/NWU
METALS BY ICP							
Cadmium	ug/l	ND(4.3)	V/U	ND(4.3)	A/U	ND(4.3)	A/U
Calcium	ug/l	NA		NA		NA	
Chromium	ug/l	ND(3.6)	V/U	ND(3.6)	A/U	ND(4.7)	A/U
Copper	ug/l	ND(4.3)	VU1/B	ND(3.3)	AU1/B	ND(4)	A/U
Iron	ug/l	NA		NA		NA	
Magnesium	ug/l	NA		NA		NA	
Manganese	ug/l	NA		NA		NA	
Nickel	ug/l	ND(24)	V/U	ND(24)	A/U	ND(27)	A/U
Potassium	ug/l	NA		NA		NA	
Sodium	ug/l	NA		NA		NA	
Zinc	ug/l	ND(21.6)	VU2	ND(22.9)	AU2	32	A
EPA-150.1							
pH	pH	NA		NA		NA	
EPA-300.0							
Sulfate	mg/l	NA		NA		NA	
Nitrate as N	mg/l	5.9	V/R	NA		4.5	A/R
Chloride	mg/l	NA		NA		NA	
Orthophosphate as P	mg/l	ND(0.2)	V	NA		ND(0.2)	A
Bromide	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-03-180	MW-12-03-180	MW-12-03-180	MW-12-04-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J12096F	9412D012244F	9423J12194F	9337J12011F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/22/94	03/23/94	06/06/94	09/16/93
Lab Sample Number:	0743010004SA	0747920012SA	0761420009SA	0716270008SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	
EPA-7041							
Antimony	ug/l	ND(2.2) V/U		6.5 A/WB		ND(2.2) A/WU	4.9 A/B
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-04-180	MW-12-04-180	MW-12-04-180	MW-12-04-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9402C012021F	9408J12097F	9412D012235F	9423J12195F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	01/14/94	02/22/94	03/21/94	06/07/94
Lab Sample Number:	0735970002SA	0743010005SA	0747920003SA	0761420014SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	0.3 A	ND(0.2) V/U	ND(0.2) A/U	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) A/U	ND(2.5) V/U	ND(2.5) A/WU	ND(2.5) A/U
FUAA-EPA7421					
Lead	ug/l	ND(2.9) A/U	ND(2.9) V/U	ND(2.9) A/U	ND(2.9) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(2.1) AJ3/NWU	ND(2.1) VJ3/NWU	ND(2.1) A/WU	ND(10.5) AJ3/NU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) V/U	ND(4.3) A/U	ND(4.3) A/U
Calcium	ug/l	21900 A/E	NA	NA	NA
Chromium	ug/l	ND(3.6) A/U	5.7 V/B	ND(3.6) A/U	ND(4.7) A/U
Copper	ug/l	ND(1.8) A/U	ND(4.6) VU1/B	ND(1.8) A/U	ND(11.4) AU1/B
Iron	ug/l	ND(56.3) AU1/B	NA	NA	NA
Magnesium	ug/l	12800 A	NA	NA	NA
Manganese	ug/l	36 A	NA	NA	NA
Nickel	ug/l	ND(24) A/U	ND(24) V/U	ND(24) A/U	ND(27) A/U
Potassium	ug/l	1970 A/B	NA	NA	NA
Sodium	ug/l	64100 A	NA	NA	NA
Zinc	ug/l	ND(35.1) AU1	ND(26.1) VU2	ND(14.5) AU2/B	ND(16.8) AU2/B
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	40.1 A/R	NA	NA	NA
Nitrate as N	mg/l	7.4 A/R	6.5 V/R	NA	6.3 A/R
Chloride	mg/l	70.3 A/R	NA	NA	NA
Orthophosphate as P	mg/l	0.21 A	0.27 V	NA	0.33 A
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
Basewide Groundwater Monitoring Annual Report
Fort Ord, California
Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-04-180	MW-12-04-180	MW-12-04-180	MW-12-04-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9402C012021F	9408J12097F	9412D012235F	9423J12195F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	01/14/94	02/22/94	03/21/94	06/07/94
Lab Sample Number:	0735970002SA	0743010005SA	0747920003SA	0761420014SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	311	A	NA		NA	
EPA-160.2							
Total Suspended Solids	mg/l	220	A	NA		NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	53.5	A	NA		NA	
Alkalinity, Total (as CaCO3)	mg/l	53.5	A	NA		NA	
EPA-7041							
Antimony	ug/l	ND(6.9)	AU2/B	ND(2.2)	V/U	2.3	A/B
SM314A							
Hardness (as CaCO3)	mg/l	108	A	NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-05-180	MW-12-05-180	MW-12-05-180	MW-12-05-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J12012F	9403C012009F	9408I12001F	9412D012243F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/16/93	01/18/94	02/22/94	03/23/94
Lab Sample Number:	0716270009SA	0735970017SA	0743010006SA	0747920011SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) V/U	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.4) A/U	ND(2.5) A/WU	ND(2.5) V/U	ND(2.5) A/U
FUAA-EPA7421					
Lead	ug/l	ND(1.6) A/U	ND(2.9) A/U	ND(2.9) V/U	ND(2.9) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(2) A/U	ND(2.1) AJ3/NU	ND(2.1) VJ3/NWU	ND(21) A/WU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) V/U	ND(4.3) A/U
Calcium	ug/l	NA	24100 A/E	NA	NA
Chromium	ug/l	ND(4.7) A/U	ND(3.6) A/U	ND(3.6) V/U	ND(3.6) A/U
Copper	ug/l	ND(4) A/U	ND(15.9) AU1/B	ND(11) VU1/B	ND(9.4) AU1/B
Iron	ug/l	NA	ND(23.8) AU1/B	NA	NA
Magnesium	ug/l	NA	16800 A	NA	NA
Manganese	ug/l	NA	7.2 A/B	NA	NA
Nickel	ug/l	ND(27) A/U	ND(24) A/U	ND(24) V/U	ND(24) A/U
Potassium	ug/l	NA	2530 A/B	NA	NA
Sodium	ug/l	NA	85100 A	NA	NA
Zinc	ug/l	20.1 A	98.1 A	ND(63.9) VU2	ND(32.5) AU2
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	37 A/R	NA	NA
Nitrate as N	mg/l	15.5 A/R	14 A/R	10.3 V/R	NA
Chloride	mg/l	NA	88 A/R	NA	NA
Orthophosphate as P	mg/l	ND(0.2) A	ND(0.2) A	ND(0.2) V	NA
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-05-180	MW-12-05-180	MW-12-05-180	MW-12-05-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9337J12012F	9403C012009F	9408I12001F	9412D012243F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	09/16/93	01/18/94	02/22/94	03/23/94
Lab Sample Number:	0716270009SA	0735970017SA	0743010006SA	0747920011SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		415	A	NA	NA
EPA-160.2							
Total Suspended Solids	mg/l	NA		17	A	NA	NA
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	NA
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		85.2	A	NA	NA
Alkalinity, Total (as CaCO3)	mg/l	NA		85.2	A	NA	NA
EPA-7041							
Antimony	ug/l	7.1 A/B		ND(7.6)	AU2/B	ND(7)	VU2/B 4.5 A/B
SM314A							
Hardness (as CaCO3)	mg/l	NA		129	A	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-05-180	MW-12-06-180	MW-12-06-180	MW-12-06-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9423J12196F	9337J12013F	9349J12064F	9403C012006F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	06/07/94	09/16/93	12/07/93	01/18/94
Lab Sample Number:	0761420015SA	0716270010SA	0730330018SA	0735970013SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	NA	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) A/U	ND(2.4) A/U	NA	ND(2.5) A/WU
FUAA-EPA7421					
Lead	ug/l	ND(2.9) A/U	ND(1.6) A/U	NA	ND(2.9) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(10.5) AJ3/NU	ND(2) A/WU	NA	ND(2.1) AJ3/NWU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	NA	ND(4.3) A/U
Calcium	ug/l	NA	NA	49200 VJ4/E	56500 A/E
Chromium	ug/l	ND(4.7) A/U	4.8 A/B	NA	5.5 A/B
Copper	ug/l	ND(4) A/U	13.7 A/B	NA	ND(7.9) AU1/B
Iron	ug/l	NA	NA	NA	ND(15) A/U
Magnesium	ug/l	NA	NA	22800 VJ4/E	29500 A
Manganese	ug/l	NA	NA	NA	2.8 A/B
Nickel	ug/l	ND(27) A/U	ND(27) A/U	NA	ND(24) A/U
Potassium	ug/l	NA	NA	2600 V/B	3550 A/B
Sodium	ug/l	NA	NA	56000 V	66100 A
Zinc	ug/l	ND(3.1) AU1/B	30.1 A	NA	ND(52.1) AU1
EPA-150.1					
pH	pH	NA	NA	7.5 V	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	61.6 V/R	55.4 A/R
Nitrate as N	mg/l	14.8 A/R	2 A	3 V	3.1 A
Chloride	mg/l	NA	NA	107 V/R	116 A/R
Orthophosphate as P	mg/l	ND(0.2) A	ND(0.2) A	NA	ND(0.2) A
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-05-180	MW-12-06-180	MW-12-06-180	MW-12-06-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9423J12196F	9337J12013F	9349J12064F	9403C012006F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	06/07/94	09/16/93	12/07/93	01/18/94
Lab Sample Number:	0761420015SA	0716270010SA	0730330018SA	0735970013SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
EPA-160.1					
Total Dissolved Solids	mg/l	NA	NA	484 V	456 A
EPA-160.2					
Total Suspended Solids	mg/l	NA	NA	NA	ND(5) A
EPA-120.1					
Specific Conductance at 25 deg. C	umhos	NA	NA	709 V	NA
EPA-INORGANICS					
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA	NA	133 V	135 A
Alkalinity, Total (as CaCO3)	mg/l	NA	NA	133 V	135 A
EPA-7041					
Antimony	ug/l	ND(2.2) A/U	6.6 A/B	NA	ND(8.7) AU2/B
SM314A					
Hardness (as CaCO3)	mg/l	NA	NA	NA	262 A

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-06-180	MW-12-06-180	MW-12-06-180	MW-12-07-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408I12005F	9412D012233F	9423J12197F	9402C012023F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/22/94	03/21/94	06/07/94	01/14/94
Lab Sample Number:	0743010010SA	0747920001SA	0761420017SA	0735970004SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
COLD VAPOR AA							
Mercury	ug/l	ND(0.2)	V/U	ND(0.2)	A/U	ND(0.2)	A/U
FUAA-EPA7060							
Arsenic	ug/l	ND(2.5)	V/U	ND(2.5)	A/WU	ND(2.5)	A/WU
FUAA-EPA7421							
Lead	ug/l	ND(2.9)	V/U	ND(2.9)	A/U	ND(2.9)	A/U
FUAA-EPA7841							
Thallium	ug/l	ND(10.5)	VJ3/NU	ND(21)	A/WU	ND(10.5)	AJ3/NWU
METALS BY ICP							
Cadmium	ug/l	ND(4.3)	V/U	ND(4.3)	A/U	ND(4.3)	A/U
Calcium	ug/l	NA		NA		NA	29200 A/E
Chromium	ug/l	7.2	V/B	ND(5.8)	AU2/B	6	A/B
Copper	ug/l	ND(18.7)	VU1/B	ND(2)	AU1/B	ND(4)	A/U
Iron	ug/l	NA		NA		NA	ND(16.6) AU1/B
Magnesium	ug/l	NA		NA		NA	17300 A
Manganese	ug/l	NA		NA		NA	47.1 A
Nickel	ug/l	ND(24)	V/U	ND(24)	A/U	ND(27)	A/U
Potassium	ug/l	NA		NA		NA	2890 A/B
Sodium	ug/l	NA		NA		NA	73800 A
Zinc	ug/l	84.6	V	ND(5.3)	AU2/B	ND(50.8)	AU1
EPA-150.1							
pH	pH	NA		NA		NA	NA
EPA-300.0							
Sulfate	mg/l	NA		NA		NA	30.8 A/R
Nitrate as N	mg/l	2.6	V	NA		2.3	A
Chloride	mg/l	NA		NA		NA	9.8 A/R
Orthophosphate as P	mg/l	ND(0.2)	V	NA		ND(0.2)	A
Bromide	mg/l	NA		NA		NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
Basewide Groundwater Monitoring Annual Report
Fort Ord, California
Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-06-180	MW-12-06-180	MW-12-06-180	MW-12-07-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408112005F	9412D012233F	9423J12197F	9402C012023F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/22/94	03/21/94	06/07/94	01/14/94
Lab Sample Number:	0743010010SA	0747920001SA	0761420017SA	0735970004SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	394 A
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	6 A
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	NA
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	122 A
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	122 A
EPA-7041							
Antimony	ug/l	ND(3.7)	VU2/B	3.9	A/B	ND(2.2)	A/U
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	144 A

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-07-180	MW-12-07-180	MW-12-07-180	MW-12-08-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408I12003F	9412D012240F	9423J12199F	9402C012024F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/22/94	03/22/94	06/07/94	01/14/94
Lab Sample Number:	0743010008SA	0747920008SA	0761420019SA	0735970005SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) V/U	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) V/U	ND(2.5) A/U	ND(2.5) A/U	ND(2.5) A/WU
FUAA-EPA7421					
Lead	ug/l	ND(2.9) V/U	ND(2.9) A/U	ND(2.9) A/U	ND(2.9) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(2.1) VJ3/NWU	ND(21) A/WU	ND(2.1) AJ3/NWU	ND(2.1) AJ3/NU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) V/U	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) A/U
Calcium	ug/l	NA	NA	NA	12300 A/E
Chromium	ug/l	ND(3.6) V/U	ND(3.6) A/U	ND(4.7) A/U	ND(3.6) A/U
Copper	ug/l	ND(6.7) VU1/B	ND(10.3) AU1/B	19.3 A/B	ND(5.5) AU1/B
Iron	ug/l	NA	NA	NA	ND(15) A/U
Magnesium	ug/l	NA	NA	NA	7100 A
Manganese	ug/l	NA	NA	NA	24.8 A
Nickel	ug/l	ND(24) V/U	ND(24) A/U	ND(27) A/U	ND(24) A/U
Potassium	ug/l	NA	NA	NA	2490 A/B
Sodium	ug/l	NA	NA	NA	52400 A
Zinc	ug/l	ND(43.2) VU2	36.6 A	ND(17.6) AU2/B	ND(39.8) AU1
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	NA	19.5 A
Nitrate as N	mg/l	14 V/R	NA	7.8 A/R	5.8 A/R
Chloride	mg/l	NA	NA	NA	37.8 A/R
Orthophosphate as P	mg/l	ND(0.2) V	NA	ND(0.2) A	ND(0.2) A
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picroCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-07-180	MW-12-07-180	MW-12-07-180	MW-12-08-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408I12003F	9412D012240F	9423J12199F	9402C012024F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/22/94	03/22/94	06/07/94	01/14/94
Lab Sample Number:	0743010008SA	0747920008SA	0761420019SA	0735970005SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	242 A
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	42 A
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	NA
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	64.4 A
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	64.4 A
EPA-7041							
Antimony	ug/l	ND(3.3)	VU2/B	5.3	A/B	4.9	A/WB ND(4.8) AU2/B
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	59.9 A

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-08-180	MW-12-08-180	MW-12-08-180	MW-12-09-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J12099F	9412D012238F	9423J12200F	9403C012008F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/23/94	03/22/94	06/07/94	01/18/94
Lab Sample Number:	0743010017SA	0747920006SA	0761420020SA	0735970015SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) V/U	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) V/U	ND(2.5) A/U	ND(2.5) A/U	ND(2.5) A/WU
FUAA-EPA7421					
Lead	ug/l	ND(2.9) V/U	ND(2.9) A/U	ND(2.9) A/U	ND(2.9) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(2.1) VJ3/NU	ND(10.5) A/U	ND(2.1) AJ3/NU	ND(2.1) AJ3/NWU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) V/U	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) A/U
Calcium	ug/l	NA	NA	NA	23500 A/E
Chromium	ug/l	ND(3.6) V/U	ND(3.6) A/U	ND(4.7) A/U	ND(3.6) A/U
Copper	ug/l	ND(1.8) VU1/B	ND(1.8) A/U	ND(4) A/U	ND(16.6) AU1/B
Iron	ug/l	NA	NA	NA	ND(18.9) AU1/B
Magnesium	ug/l	NA	NA	NA	12900 A
Manganese	ug/l	NA	NA	NA	44.8 A
Nickel	ug/l	ND(24) V/U	ND(24) A/U	ND(27) A/U	ND(24) A/U
Potassium	ug/l	NA	NA	NA	3680 A/B
Sodium	ug/l	NA	NA	NA	69400 A
Zinc	ug/l	ND(24.4) VU2	ND(6.6) AU2/B	ND(1.8) AU1/B	ND(85.4) AU1
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	NA	45.3 A/R
Nitrate as N	mg/l	6.2 V/R	NA	5.3 A/R	3.6 A/G
Chloride	mg/l	NA	NA	NA	83 A/R
Orthophosphate as P	mg/l	0.2 V	NA	0.2 A	ND(0.2) A
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picroCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-08-180	MW-12-08-180	MW-12-08-180	MW-12-09-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J12099F	9412D012238F	9423J12200F	9403C012008F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/23/94	03/22/94	06/07/94	01/18/94
Lab Sample Number:	0743010017SA	0747920006SA	0761420020SA	0735970015SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	345 A
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	ND(5) A
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	NA
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	61.7 A
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	61.7 A
EPA-7041							
Antimony	ug/l	ND(2.4)	VU2/B	ND(2.2)	A/U	ND(2.2)	A/U
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	112 A

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-09-180	MW-12-09-180	MW-12-09-180	MW-12-10-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J12100F	9412D012237F	9423J12202F	9408J12101F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/23/94	03/22/94	06/08/94	02/23/94
Lab Sample Number:	0743010018SA	0747920005SA	0761680012SA	0743010019SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) V/U	ND(0.2) A/U	ND(0.2) A/U	ND(0.2) V/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) V/U	ND(2.5) A/U	ND(2.5) A/U	ND(2.5) V/U
FUAA-EPA7421					
Lead	ug/l	ND(2.9) V/U	ND(2.9) A/U	ND(2.9) A/U	ND(2.9) V/U
FUAA-EPA7841					
Thallium	ug/l	ND(2.1) VJ3/NWU	ND(21) A/WU	ND(2.1) AJ3/NWU	ND(10.5) VJ3/NU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) V/U	ND(4.3) A/U	ND(4.3) A/U	ND(4.3) V/U
Calcium	ug/l	NA	NA	NA	NA
Chromium	ug/l	ND(3.6) V/U	ND(6.1) AU2/B	3.7 A/B	ND(3.6) V/U
Copper	ug/l	ND(5.8) VU1/B	ND(10.3) AU1/B	6.1 A/B	ND(26.3) VU1
Iron	ug/l	NA	NA	NA	ND(15) V/U
Magnesium	ug/l	NA	NA	NA	NA
Manganese	ug/l	NA	NA	NA	503 V
Nickel	ug/l	ND(24) V/U	ND(24) A/U	ND(24) A/U	28 V/B
Potassium	ug/l	NA	NA	NA	NA
Sodium	ug/l	NA	NA	NA	NA
Zinc	ug/l	ND(8.1) VU2/B	ND(27.4) AU2	41.4 A	81.8 V
EPA-150.1					
pH	pH	NA	NA	NA	6.5 V
EPA-300.0					
Sulfate	mg/l	NA	NA	NA	NA
Nitrate as N	mg/l	4.1 V	NA	4.4 A	7.3 V/R
Chloride	mg/l	NA	NA	NA	NA
Orthophosphate as P	mg/l	ND(0.2) V	NA	ND(0.2) A	ND(0.2) V
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-09-180	MW-12-09-180	MW-12-09-180	MW-12-10-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J12100F	9412D012237F	9423J12202F	9408J12101F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/23/94	03/22/94	06/08/94	02/23/94
Lab Sample Number:	0743010018SA	0747920005SA	0761680012SA	0743010019SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	713 V
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	ND(5) V
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	1150 V
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	229 V
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	229 V
EPA-7041							
Antimony	ug/l	ND(2.2) V/U		7 A/B		ND(2.2) A/U	ND(1.5) V/U
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	413 V

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-10-180	MW-12-10-180	MW-14-04-A	MW-16-01-A
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9412D012247F	9423J12204F	9349J14058F	9350J16085F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	03/23/94	06/08/94	12/06/93	12/13/93
Lab Sample Number:	0747920015SA	0761680014SA	0730330005SA	0731730001SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	NA	ND(0.2) A/U
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) A/U	ND(2.5) A/U	NA	ND(2.4) A/U
FUAA-EPA7421					
Lead	ug/l	ND(2.9) A/U	ND(2.9) A/U	NA	ND(1.6) A/U
FUAA-EPA7841					
Thallium	ug/l	ND(21) A/WU	ND(2.1) A/J3/NWU	NA	ND(2) A/WU
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	NA	ND(4.3) A/U
Calcium	ug/l	NA	NA	51800 VJ4/E	NA
Chromium	ug/l	ND(3.6) A/U	ND(3.6) A/U	NA	ND(4.7) A/U
Copper	ug/l	ND(8.3) AU1/B	ND(1.8) A/U	NA	ND(6.6) AU1/B
Iron	ug/l	NA	NA	NA	NA
Magnesium	ug/l	NA	NA	32900 VJ4/E	NA
Manganese	ug/l	NA	NA	NA	NA
Nickel	ug/l	ND(24) A/U	ND(24) A/U	NA	ND(27) A/U
Potassium	ug/l	NA	NA	4480 V/B	NA
Sodium	ug/l	NA	NA	154000 V	27900 A
Zinc	ug/l	42.2 A	13.8 A/B	NA	39.6 A
EPA-150.1					
pH	pH	NA	NA	6.6 V	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	73.2 V/R	NA
Nitrate as N	mg/l	NA	6 A/R	6.2 V/R	NA
Chloride	mg/l	NA	NA	242 V/R	NA
Orthophosphate as P	mg/l	NA	0.26 A	NA	NA
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.

ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-12-10-180	MW-12-10-180	MW-14-04-A	MW-16-01-A
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9412D012247F	9423J12204F	9349J14058F	9350J16085F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	03/23/94	06/08/94	12/06/93	12/13/93
Lab Sample Number:	0747920015SA	0761680014SA	0730330005SA	0731730001SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
EPA-160.1					
Total Dissolved Solids	mg/l	NA	NA	742 V	NA
EPA-160.2					
Total Suspended Solids	mg/l	NA	NA	NA	NA
EPA-120.1					
Specific Conductance at 25 deg. C	umhos	NA	NA	1140 V	NA
EPA-INORGANICS					
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA	NA	169 V	NA
Alkalinity, Total (as CaCO3)	mg/l	NA	NA	169 V	NA
EPA-7041					
Antimony	ug/l	5.1 A/B	2.6 A/B	NA	9.6 A/WB
SM314A					
Hardness (as CaCO3)	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-16-01-A	MW-16-01-A	MW-18-01-180	MW-18-01-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J16113F	9423J16218F	9338J18026F	9349J18076F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/25/94	06/09/94	09/21/93	12/09/93
Lab Sample Number:	0743650012SA	0762030012SA	0716580009SA	0730760006SA

Test Method/Analyte Name	Units	value qual	value qual	value qual	value qual
COLD VAPOR AA					
Mercury	ug/l	ND(0.2) A/U	ND(0.2) A/U	NA	NA
FUAA-EPA7060					
Arsenic	ug/l	ND(2.5) A/U	ND(2.5) A/WU	NA	NA
FUAA-EPA7421					
Lead	ug/l	ND(2.9) A/U	ND(2.9) A/U	NA	NA
FUAA-EPA7841					
Thallium	ug/l	ND(2.1) AJ3/NU	ND(2.1) AJ3/NWU	NA	NA
METALS BY ICP					
Cadmium	ug/l	ND(4.3) A/U	ND(4.3) A/U	NA	NA
Calcium	ug/l	NA	NA	NA	NA
Chromium	ug/l	ND(3.6) A/U	ND(3.6) A/U	NA	NA
Copper	ug/l	ND(1.8) A/U	ND(1.8) A/U	NA	NA
Iron	ug/l	NA	NA	NA	NA
Magnesium	ug/l	NA	NA	NA	NA
Manganese	ug/l	NA	NA	NA	NA
Nickel	ug/l	ND(24) A/U	ND(24) A/U	NA	NA
Potassium	ug/l	NA	NA	NA	NA
Sodium	ug/l	NA	NA	NA	NA
Zinc	ug/l	ND(41.9) AU2	ND(10.6) AU1/B	NA	NA
EPA-150.1					
pH	pH	NA	NA	NA	NA
EPA-300.0					
Sulfate	mg/l	NA	NA	NA	NA
Nitrate as N	mg/l	NA	NA	12.3 A/R	13.2 A/R
Chloride	mg/l	NA	NA	NA	NA
Orthophosphate as P	mg/l	NA	NA	NA	NA
Bromide	mg/l	NA	NA	NA	NA

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Table 3. Analytical Results for Inorganic Compounds Detected in Groundwater Samples
 Basewide Groundwater Monitoring Annual Report
 Fort Ord, California
 Date Range: 09/14/93 - 06/14/94

Station Number:	MW-16-01-A	MW-16-01-A	MW-18-01-180	MW-18-01-180
Sample Depth(feet):	0.00	0.00	0.00	0.00
Sample Number:	9408J16113F	9423J16218F	9338J18026F	9349J18076F
Matrix:	H2O	H2O	H2O	H2O
Sample Date:	02/25/94	06/09/94	09/21/93	12/09/93
Lab Sample Number:	0743650012SA	0762030012SA	0716580009SA	0730760006SA

Test Method/Analyte Name	Units	value	qual	value	qual	value	qual
EPA-160.1							
Total Dissolved Solids	mg/l	NA		NA		NA	
EPA-160.2							
Total Suspended Solids	mg/l	NA		NA		NA	
EPA-120.1							
Specific Conductance at 25 deg. C	umhos	NA		NA		NA	
EPA-INORGANICS							
Alkalinity, Bicarb. (as CaCO3)	mg/l	NA		NA		NA	
Alkalinity, Total (as CaCO3)	mg/l	NA		NA		NA	
EPA-7041							
Antimony	ug/l	3.6 A/B		11.4 A		NA	
SM314A							
Hardness (as CaCO3)	mg/l	NA		NA		NA	

Notes: Units expressed as nanograms (ng), micrograms (ug), milligrams (mg),
 picoCuries (pCi) or million structures (ms) of chemical per liter (l) of water.

NA: Not Analyzed.
 ND(): Not Detected at a specific detection limit. Limit of detection is included in parentheses.

Report Date: Jun 27, 1996

Chemical Data Report - Positive Chemical Results Only
 Site 03
 Beach Trainfire Ranges
 Fort Ord, California
 Date Range: 09/01/93-05/23/94

Sample Number	Sample Depth	Station Number	Sample Date	Test Method	Analyte	Units	Value	Detection Limit	HLA Qual	Lab Qual
9340T003049F	0.99	CONTROL-A-31	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	7.90	2.00	V	
9340T003050F	2.00	CONTROL-A-31	12/02/93	EPA6010	Chromium	mg/kg	13.40	0.97	V	
9340T003050F	2.00	CONTROL-A-31	12/02/93	EPA6010	Iron	mg/kg	6490.00	9.90	V	
9340T003050F	2.00	CONTROL-A-31	12/02/93	EPA6010	Zinc	mg/kg	10.60	0.35	VJ4	E
9340T003050F	2.00	CONTROL-A-31	12/02/93	EPA7211	Copper	mg/kg	1.80	0.20	V	N
9340T003050F	2.00	CONTROL-A-31	12/02/93	EPA9045	pH	pH	7.30	0.00	VJ5	
9340T003050F	2.00	CONTROL-A-31	12/02/93	EPA9060	Total Organic Carbon	mg/kg	1180.00	100.00	V	
9340T003050F	2.00	CONTROL-A-31	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	6.40	2.00	V	
* Station Number * CONTROL-BEACH PT * Matrix Type * SOIL										
9340T003051F	0.13	CONTROL-BEACH PT	12/02/93	EPA6010	Chromium	mg/kg	3.80	0.93	V	
9340T003051F	0.13	CONTROL-BEACH PT	12/02/93	EPA6010	Iron	mg/kg	2010.00	9.40	V	
9340T003051F	0.13	CONTROL-BEACH PT	12/02/93	EPA7211	Copper	mg/kg	0.65	0.20	V	N
9340T003051F	0.13	CONTROL-BEACH PT	12/02/93	EPA9045	pH	pH	6.80	0.00	VJ5	
9340T003051F	0.13	CONTROL-BEACH PT	12/02/93	EPA9060	Total Organic Carbon	mg/kg	284.00	100.00	V	
9340T003051F	0.13	CONTROL-BEACH PT	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	4.20	1.00	V	
9340T003052F	0.99	CONTROL-BEACH PT	12/02/93	EPA6010	Chromium	mg/kg	3.20	0.95	V	
9340T003052F	0.99	CONTROL-BEACH PT	12/02/93	EPA6010	Iron	mg/kg	1810.00	9.60	V	
9340T003052F	0.99	CONTROL-BEACH PT	12/02/93	EPA7211	Copper	mg/kg	0.47	0.20	V	N
9340T003052F	0.99	CONTROL-BEACH PT	12/02/93	EPA9045	pH	pH	7.30	0.00	VJ5	
9340T003052F	0.99	CONTROL-BEACH PT	12/02/93	EPA9060	Total Organic Carbon	mg/kg	229.00	100.00	V	
9340T003052F	0.99	CONTROL-BEACH PT	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	6.30	2.00	V	
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA6010	Chromium	mg/kg	3.60	0.95	V	
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA6010	Iron	mg/kg	2150.00	9.60	V	
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA6010	Lead	mg/kg	14.20	9.70	V	
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA6010	Zinc	mg/kg	7.30	0.35	VJ4	E
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA7211	Copper	mg/kg	1.00	0.20	V	N
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA9045	pH	pH	7.70	0.00	VJ5	
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA9060	Total Organic Carbon	mg/kg	317.00	100.00	V	
9340T003053F	2.00	CONTROL-BEACH PT	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	2.00	1.00	V	
* Station Number * CONTROL-S-31 * Matrix Type * LEACHATE										
9340T003042FSR	0.13	CONTROL-S-31	12/02/93	EPA9001	EPA % Moisture	%	0.54	0.10	A	
9340T003042FSR	0.13	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	2.80	0.00	A	
9340T003042FSR	0.13	CONTROL-S-31	12/02/93	EPA200.7	Iron	mg/l	1.80	0.50	A	

Notes:

Fecal Coliform results reported as Most Probable Number (MPN) per 10 grams for soil samples and MPN per 100 milliliters for water samples.

ND: Not Detected
 NR: Not Reported
 NA: Not Analyzed

Report Date: Jun 27, 1994

Chemical Data Report - Positive Chemical Results Only
 Site 03
 Beach Trainfire Ranges
 Fort Ord, California
 Date Range: 09/01/93-05/23/94

Sample Number	Sample Depth	Station Number	Sample Date	Test Method	Analyte	Units	Value	Detection Limit	HLA Qual	Lab Qual
9348T003042FSS	0.13	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	6.90	0.00	A	
9348T003042FUR	0.13	CONTROL-S-31	12/02/93	EPA%MOIST	EPA % Moisture	%	0.54	0.10	A	
9348T003042FUR	0.13	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	2.80	0.00	A	
9348T003042FUR	0.13	CONTROL-S-31	12/02/93	EPA200.7	Iron	mg/l	1.20	0.50	AJ3	
9348T003042FUS	0.13	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	6.70	0.00	A	
9348T003044FBR	0.88	CONTROL-S-31	12/02/93	EPA%MOIST	EPA % Moisture	%	1.20	0.10	A	
9348T003044FBR	0.88	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	2.80	0.00	A	
9348T003044FBR	0.88	CONTROL-S-31	12/02/93	EPA200.7	Iron	mg/l	1.20	0.50	A	
9348T003044FSS	0.88	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	7.10	0.00	A	
9348T003044FUR	0.88	CONTROL-S-31	12/02/93	EPA%MOIST	EPA % Moisture	%	1.20	0.10	A	
9348T003044FUR	0.88	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	2.20	0.00	A	
9348T003044FUR	0.88	CONTROL-S-31	12/02/93	EPA200.7	Iron	mg/l	1.30	0.50	AJ3	
9348T003044FUS	0.88	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	6.50	0.00	A	
9348T003044FUS	0.88	CONTROL-S-31	12/02/93	EPA218.2	Chromium	mg/l	0.02	0.01	A	
9348T003046FBR	2.25	CONTROL-S-31	12/02/93	EPA%MOIST	EPA % Moisture	%	1.70	0.10	A	
9348T003046FBR	2.25	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	2.50	0.00	A	
9348T003046FBR	2.25	CONTROL-S-31	12/02/93	EPA200.7	Iron	mg/l	1.20	0.50	A	
9348T003046FSS	2.25	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	7.40	0.00	A	
9348T003046FUR	2.25	CONTROL-S-31	12/02/93	EPA%MOIST	EPA % Moisture	%	1.70	0.10	A	
9348T003046FUR	2.25	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	2.80	0.00	A	
9348T003046FUR	2.25	CONTROL-S-31	12/02/93	EPA200.7	Iron	mg/l	2.60	0.50	AJ3	
9348T003046FUS	2.25	CONTROL-S-31	12/02/93	EPA150.1	pH	pH	7.00	0.00	A	
* Station Number * CONTROL-S-31 * Matrix Type * SOIL										
9348T003043F	0.13	CONTROL-S-31	12/02/93	EPA6010	Chromium	mg/kg	17.50	0.94	V	
9348T003043F	0.13	CONTROL-S-31	12/02/93	EPA6010	Iron	mg/kg	8560.00	9.50	V	
9348T003043F	0.13	CONTROL-S-31	12/02/93	EPA6010	Zinc	mg/kg	12.50	0.34	VJ4	E
9348T003043F	0.13	CONTROL-S-31	12/02/93	EPA7211	Copper	mg/kg	2.00	0.20	V	N

Notes:

Fecal Coliform results reported as Most Probable Number (MPN) per 10 grams for soil samples and MPN per 100 milliliters for water samples.

ND: Not Detected
 NR: Not Reported
 NA: Not Analyzed

Report Date: Jun 27, 1994

Chemical Data Report - Positive Chemical Results Only
 Site 03
 Beach Trainfire Ranges
 Fort Ord, California
 Date Range: 09/01/93-05/23/94

Sample Number	Sample Depth	Station Number	Sample Date	Test Method	Analyte	Units	Value	Detection Limit	HLA Qual	Lab Qual
9348T003043F	0.13	CONTROL-S-31	12/02/93	EPA9045	pH	pH	5.20	0.00	VJ5	
9348T003043F	0.13	CONTROL-S-31	12/02/93	EPA9060	Total Organic Carbon	mg/kg	721.00	100.00	V	
9348T003043F	0.13	CONTROL-S-31	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	7.70	2.00	V	
9348T003045F	0.08	CONTROL-S-31	12/02/93	EPA6010	Chromium	mg/kg	15.10	0.94	V	
9348T003045F	0.08	CONTROL-S-31	12/02/93	EPA6010	Iron	mg/kg	7190.00	9.50	V	
9348T003045F	0.08	CONTROL-S-31	12/02/93	EPA6010	Zinc	mg/kg	9.90	0.34	VJ4	E
9348T003045F	0.08	CONTROL-S-31	12/02/93	EPA7211	Copper	mg/kg	1.70	0.20	V	N
9348T003045F	0.08	CONTROL-S-31	12/02/93	EPA9045	pH	pH	5.10	0.00	VJ5	
9348T003045F	0.08	CONTROL-S-31	12/02/93	EPA9060	Total Organic Carbon	mg/kg	626.00	100.00	V	
9348T003045F	0.08	CONTROL-S-31	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	8.00	2.00	V	
9348T003047F	2.25	CONTROL-S-31	12/02/93	EPA6010	Chromium	mg/kg	12.20	0.95	V	
9348T003047F	2.25	CONTROL-S-31	12/02/93	EPA6010	Iron	mg/kg	6590.00	9.60	V	
9348T003047F	2.25	CONTROL-S-31	12/02/93	EPA6010	Zinc	mg/kg	10.80	0.35	VJ4	E
9348T003047F	2.25	CONTROL-S-31	12/02/93	EPA7211	Copper	mg/kg	1.40	0.20	V	N
9348T003047F	2.25	CONTROL-S-31	12/02/93	EPA9045	pH	pH	5.60	0.00	VJ5	
9348T003047F	2.25	CONTROL-S-31	12/02/93	EPA9060	Total Organic Carbon	mg/kg	742.00	100.00	V	
9348T003047F	2.25	CONTROL-S-31	12/02/93	EPA9081	Cation Exchange Capacity as Na	meq/100	8.70	2.00	V	
* Station Number * FIELD BLANK * Matrix Type * AIR										
9345P003023C	0.00	FIELD BLANK	11/07/93	EPA6010	Zinc	ug/filt	121.00	0.76	A	B
9345P003023C	0.00	FIELD BLANK	11/07/93	EPA7211	Copper	ug/filt	0.85	0.36	A	
9345P003023C	0.00	FIELD BLANK	11/07/93	EPAPM10	Final Weight	gm	4.36	0.00	A	
9345P003023C	0.00	FIELD BLANK	11/07/93	EPAPM10	Initial Weight	gm	4.36	0.00	A	
9345P003023C	0.00	FIELD BLANK	11/07/93	EPAPM10	Total Suspended Particulates	gm	NA	0.00	A	
* Station Number * OT-03-30CAL * Matrix Type * BULLFRAG										
9406Q003101F	0.00	OT-03-30CAL	11/22/93	EPA6010	Antimony	mg/kg	3100.00	175.00		R
9406Q003101F	0.00	OT-03-30CAL	11/22/93	EPA6010	Cadmium	mg/kg	67.50	14.60		Q
9406Q003101F	0.00	OT-03-30CAL	11/22/93	EPA6010	Copper	mg/kg	57800.00	58.40		R
9406Q003101F	0.00	OT-03-30CAL	11/22/93	EPA6010	Iron	mg/kg	120000.00	292.00		R
9406Q003101F	0.00	OT-03-30CAL	11/22/93	EPA6010	Lead	mg/kg	766000.00	292.00		R
9406Q003101F	0.00	OT-03-30CAL	11/22/93	EPA6010	Zinc	mg/kg	6610.00	58.40		R
9406Q003101F	0.00	OT-03-30CAL	11/22/93	EPA7060	Arsenic	mg/kg	161.00	14.60		R

* Station Number * OT-03-45CAL * Matrix Type * BULLFRAG

Notes:

Fecal Coliform results reported as Most Probable Number (MPN) per 10 grams for soil samples and MPN per 100 milliliters for water samples.

ND: Not Detected
 NR: Not Reported
 NA: Not Analyzed

Report Date: Jun 27, 1994

Chemical Data Report - Positive Chemical Results Only
 Site 03
 Beach Trainfire Ranges
 Fort Ord, California
 Date Range: 09/01/93-05/23/94

Sample Number	Sample Depth	Station Number	Sample Date	Test Method	Analyte	Units	Value	Detection Limit	HLA Qual	Lab Qual
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA6010	Antimony	mg/kg	1170.00	86.70		Q
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA6010	Cadmium	mg/kg	37.60	7.20		Q
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA6010	Copper	mg/kg	152000.00	57.80		R
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA6010	Lead	mg/kg	496000.00	144.00		R
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA6010	Nickel	mg/kg	104.00	57.80		Q
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA6010	Zinc	mg/kg	17900.00	28.90		R
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA7060	Arsenic	mg/kg	10.30	1.40		R
9406Q003102F	0.00	OT-03-45CAL	11/22/93	EPA7471	Mercury	mg/kg	0.07	0.01		
* Station Number * OT-03-5.56MM * Matrix Type * BULLFRAG										
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA6010	Antimony	mg/kg	6750.00	380.00		R
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA6010	Cadmium	mg/kg	53.20	31.70		Q
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA6010	Copper	mg/kg	319000.00	127.00		R
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA6010	Lead	mg/kg	687000.00	317.00		R
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA6010	Zinc	mg/kg	37100.00	127.00		R
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA7060	Arsenic	mg/kg	150.00	15.80		R
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA7471	Mercury	mg/kg	0.13	0.04		
9406Q003104F	0.00	OT-03-5.56MM	11/22/93	EPA7740	Selenium	mg/kg	12.60	3.20		R
* Station Number * OT-03-5.56SHELL * Matrix Type * BULLFRAG										
9406Q003105F	0.00	OT-03-5.56SHELL	11/22/93	EPA6010	Copper	mg/kg	712000.00	327.00		R
9406Q003105F	0.00	OT-03-5.56SHELL	11/22/93	EPA6010	Iron	mg/kg	468.00	327.00		Q
9406Q003105F	0.00	OT-03-5.56SHELL	11/22/93	EPA6010	Lead	mg/kg	261.00	163.00		Qd
9406Q003105F	0.00	OT-03-5.56SHELL	11/22/93	EPA6010	Zinc	mg/kg	286000.00	65.40		R
9406Q003105F	0.00	OT-03-5.56SHELL	11/22/93	EPA7060	Arsenic	mg/kg	3.40	0.82		R
9406Q003105F	0.00	OT-03-5.56SHELL	11/22/93	EPA7471	Mercury	mg/kg	0.03	0.02		
9406Q003105F	0.00	OT-03-5.56SHELL	11/22/93	EPA7740	Selenium	mg/kg	12.00	1.60		R
* Station Number * OT-03-7.62MM * Matrix Type * BULLFRAG										
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Antimony	mg/kg	2000.00	126.00		Q
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Cadmium	mg/kg	47.80	10.50		Q
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Copper	mg/kg	283000.00	83.90		R
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Lead	mg/kg	483000.00	210.00		R
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Nickel	mg/kg	111.00	83.90		Q
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Zinc	mg/kg	35900.00	41.90		R
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA7060	Arsenic	mg/kg	0.71	0.52		Q
9406Q003100F	0.00	OT-03-7.62MM	11/22/93	EPA7471	Mercury	mg/kg	0.08	0.01		

Notes:

Fecal Coliform results reported as Most Probable Number (MPN) per 10 grams for soil samples and MPN per 100 milliliters for water samples.

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Report Date: Jun 27, 1994

Chemical Data Report - Positive Chemical Results Only
 Site 03
 Beach Trainfire Ranges
 Fort Ord, California
 Date Range: 09/01/93-05/23/94

Sample Number	Sample Depth	Station Number	Sample Date	Test Method	Analyte	Units	Value	Detection Limit	HLA Qual	Lab Qual
9406Q003103F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Antimony	mg/kg	2510.00	126.00		R
9406Q003103F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Cadmium	mg/kg	43.30	10.50		Q
9406Q003103F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Copper	mg/kg	326000.00	94.20		R
9406Q003103F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Lead	mg/kg	617000.00	210.00		R
9406Q003103F	0.00	OT-03-7.62MM	11/22/93	EPA6010	Zinc	mg/kg	37900.00	42.10		R
9406Q003103F	0.00	OT-03-7.62MM	11/22/93	EPA7060	Arsenic	mg/kg	4.10	0.53		R
9406Q003103F	0.00	OT-03-7.62MM	11/22/93	EPA7471	Mercury	mg/kg	0.05	0.01		
* Station Number * OT-03-7.62SHELL * Matrix Type * BULLFRAG										
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA6010	Antimony	mg/kg	90.50	90.50		Q
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA6010	Copper	mg/kg	613000.00	151.00		R
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA6010	Lead	mg/kg	334.00	75.40		Q
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA6010	Nickel	mg/kg	115.00	60.30		Q
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA6010	Zinc	mg/kg	258000.00	151.00		R
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA7060	Arsenic	mg/kg	4.20	0.38		R
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA7471	Mercury	mg/kg	0.01	0.01		
9406Q003106F	0.00	OT-03-7.62SHELL	11/22/93	EPA7740	Selenium	mg/kg	43.00	7.50		R
* Station Number * OT-03-CASINGS * Matrix Type * BULLFRAG										
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA6010	Antimony	mg/kg	1740.00	142.00		Q
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA6010	Cadmium	mg/kg	17.30	11.80		Q
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA6010	Copper	mg/kg	623000.00	237.00		R
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA6010	Iron	mg/kg	354.00	237.00		Q
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA6010	Lead	mg/kg	235000.00	118.00		R
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA6010	Zinc	mg/kg	70500.00	47.30		R
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA7060	Arsenic	mg/kg	26.00	5.90		R
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA7471	Mercury	mg/kg	0.11	0.01		
9406Q003108F	0.00	OT-03-CASINGS	11/22/93	EPA7740	Selenium	mg/kg	6.70	2.40		R
* Station Number * OT-03-ENCRUST * Matrix Type * BULLFRAG										
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA6010	Antimony	mg/kg	3110.00	110.00		R
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA6010	Cadmium	mg/kg	38.20	9.10		Q
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA6010	Copper	mg/kg	29400.00	36.50		R
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA6010	Iron	mg/kg	29000.00	183.00		R
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA6010	Lead	mg/kg	688000.00	183.00		R
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA6010	Tin	mg/kg	516.00	183.00		Q

Notes:

Fecal Coliform results reported as Most Probable Number (MPN) per 10 grams for soil samples and MPN per 100 milliliters for water samples.

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Report Date: Jun 27, 1994

Chemical Data Report - Positive Chemical Results Only
 Site 03
 Beach Trainfire Ranges
 Fort Ord, California
 Date Range: 09/01/93-05/23/94

Sample Number	Sample Depth	Station Number	Sample Date	Test Method	Analyte	Units	Value	Detection Limit	HLA Qual	Lab Qual
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA6010	Zinc	mg/kg	3260.00	36.50		R
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA7060	Arsenic	mg/kg	5.80	0.91		R
9406Q003109F	0.00	OT-03-ENCRUST	11/22/93	EPA7471	Mercury	mg/kg	0.76	0.02		R
* Station Number * OT-03-LEAD * Matrix Type * BULLFRAG										
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA6010	Antimony	mg/kg	3260.00	274.00		Q
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA6010	Cadmium	mg/kg	59.80	22.80		Q
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA6010	Copper	mg/kg	167000.00	91.40		R
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA6010	Lead	mg/kg	793000.00	228.00		R
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA6010	Tin	mg/kg	971.00	457.00		Q
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA6010	Zinc	mg/kg	20700.00	91.40		R
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA7060	Arsenic	mg/kg	14.20	1.10		R
9406Q003107F	0.00	OT-03-LEAD	11/22/93	EPA7471	Mercury	mg/kg	0.05	0.03		
* Station Number * RAINWATER * Matrix Type * H2O										
9345P003023F	0.00	RAINWATER	11/12/93	EPA150.1	pH	ph	5.00	0.00	A	

Notes:

Fecal Coliform results reported as Most Probable Number (MPN) per 10 grams for soil samples and MPN per 100 milliliters for water samples.

ND: Not Detected
 NR: Not Reported
 NA: Not Analyzed

Description of Organic Qualifiers Used in Database

HLA Validation Assigned Qualifiers

- A: Sample has undergone routine data validation.
- F: The presence of this compound is due to suspected field contamination.
- J0: Analytical results for this compound are qualified as estimated due to noncompliance with internal standard area count or retention time criteria.
- J1: Analytical results for this compound are qualified as estimated due to noncompliance with instrument performance criteria.
- J2: Analytical results for this compound are qualified as estimated due to noncompliance with precision criteria.
- J3: Analytical results for this compound are qualified as estimated due to poor spike recoveries.
- J5: Analytical results for this compound are qualified as estimated due to holding time exceedances.
- J6: Analytical results for this compound are qualified as estimated due to field duplicate quality control criteria exceedances.
- J7: Analytical results for this compound are qualified as estimated due to linearity problems in the initial calibration.
- J9: Analytical results for this compound are qualified as estimated due to detection of the compound above the instrument calibration range.
- J*: Analytical results for this compound are qualified as estimated due to miscellaneous lab errors.
- M1: Analytical results for this compound are qualified as presumptively present due to its presence as a tentatively identified compound.
- R0: Analytical results for this compound are qualified as rejected due to noncompliance with internal standard area count or retention time criteria.
- R1: Analytical results for this compound are qualified as rejected due to holding time exceedances.
- R2: Analytical results for this compound are qualified as rejected due to poor spike recoveries.
- R3: Analytical results for this compound are qualified as rejected due to noncompliance with instrument performance criteria.
- R5: Analytical results for this compound are qualified as rejected due to incorrect identification
- R6: Analytical results for this compound are qualified as rejected due to noncompliance with the full CLP validation.
- R7: Analytical results for this compound are qualified as rejected due to noncompliance with initial calibration and/or continuing calibration criteria.
- U1: Compound is qualified as non-detected due to its occurrence in the laboratory blanks.
- U2: Compound is qualified as non-detected due to its occurrence in the field blanks.
- U5: Analytical results for this compound are qualified as non-detected due to incorrect identification
- V: Sample has undergone detailed data validation.

Description of Organic Qualifiers Used in Database

Laboratory Assigned Qualifiers

- 1: Hydrocarbons present in this sample represent an unknown mixture in the diesel range. Quantification based on diesel references.
- 2: Quantitation based on a Gasoline Reference Curve.
- a: Or structurally similar compound.
- b: Analytical results should not be considered reliable for this common lab contaminant, unless the sample result exceeds five times the reporting limit or ten times the blank result.
- c: Contains free liquids.
- j: All reporting limits for this sample raised due to matrix interferences.
- r: Reporting limit changed due to sample volume limitations.
- u: All reporting limits raised due to high level of analyte present in sample.
- B: Compound is also detected in the laboratory method blank.
- D: Compound is identified in an analysis at a secondary dilution factor.
- E: Concentration exceeds the calibration range of the GC/MS instrument for the specific analysis.
- G: Reporting limit raised due to matrix interference.
- J: Result is detected below the reporting limit or is an estimated concentration.
- M: Duplicate precision not met.
- Q: Reporting limit raised due to high level of another analyte in the sample.
- R: Reporting limit raised due to high level of analyte present in sample.
- U: Compound was analyzed for but not detected.
- X,Y: Specific flag used to properly define the results. Qualifier is fully described in the Sample Data Summary Package and the Case Narrative.
- z: Result detected below lowest calibration standard, but above zero.
- *: Duplicate analysis not within control limits.
- +: Correlation coefficient for the MSA is less than 0.995.
- #: Recovery outside QC Limits.

Description of Inorganic Qualifiers Used in Database

HLA Validation Assigned Qualifiers

- A: Sample has undergone routine data validation.
- J1: Analytical results for this compound are qualified as estimated due to noncompliance with instrument performance criteria.
- J2: Analytical results for this compound are qualified as estimated due to laboratory matrix duplicate quality control criteria exceedances.
- J3: Analytical results for this compound are qualified as estimated due to poor spike recoveries.
- J4: Analytical results for this compound are qualified as estimated due to ICP-serial dilution relative percent difference quality control criteria exceedances.
- J5: Analytical results for this compound are qualified as estimated due to holding time exceedances.
- J6: Analytical results for this compound are qualified as estimated due to field duplicate quality control criteria exceedances.
- J7: Analytical results for this compound are qualified as estimated due to noncompliance with initial calibration and/or continuing calibration criteria.
- J9: Analytical results for this compound are qualified as estimated due to noncompliance with ICP interference check sample criteria.
- J*: Analytical results for this compound are qualified as estimated due to miscellaneous lab errors.
- R1: Analytical results for this compound are qualified as rejected due to holding time exceedances.
- R2: Analytical results for this compound are qualified as rejected due to poor spike recoveries.
- R7: Analytical results for this compound are qualified as rejected due to noncompliance with initial calibration and/or continuing calibration criteria.
- R9: Analytical results for this compound are qualified as rejected due to noncompliance with ICP interference check sample criteria.
- U1: Compound is qualified as non-detected due to its occurrence in the laboratory blanks.
- U2: Compound is qualified as non-detected due to its occurrence in the field blanks.
- V: Sample has undergone detailed data validation.

Description of Inorganic Qualifiers Used in Database

Laboratory Assigned Qualifiers

- B: Reported value is less than the CRDL and greater than or equal to the instrument detection limit.
- E: The reported value is estimated because of the presence of interference.
- G: Reporting limit raised due to matrix interference.
- M: Duplicate injection prediction not met.
- N: Spiked sample recovery not within control limits.
- R: Reporting limit raised due to high level of analyte present in sample.
- S: The reported value was determined by the Method of Standard Additions (MSA).
- U: Compound was analyzed for but not detected.
- W: Post-digestion spike for furnace AA analysis is outside of control limits.
- *: Duplicate analysis not within control limits.
- + : Correlation coefficient for the MSA is less than 0.995.
- # : Recovery outside QC Limits.

Chemical Data Report - All Chemical Results

A chemical data report is available in electronic format (3 1/2" diskette) on request. Contact Ms. Gail Youngblood if you require a copy of this data:

Commander
U.S. Army Garrison and Fort Ord
Attn: AFZW-DPW-ENG (Ms. Gail Youngblood)
Fort Ord, California 93941-5000
(408) 242-8017

APPENDIX C
PARTICLE SIZE ANALYSES

PARTICLE SIZE ANALYSES

This appendix presents the results of the particle size analyses. The soil samples were analyzed by Solea Laboratory using ASTM D 422. The general laboratory procedures are described below.

Each soil sample was initially classified by the laboratory technician in general accordance with the Unified Soil Classification System. A representative sample was obtained and dried in an oven at 110 (plus or minus 5) degrees Celsius until its mass did not change over a period of 1 hour. The dry mass was recorded. The sample was then fully inundated with water. After soaking, the sample was placed in a U.S. Standard No. 200 sieve. The sieve was agitated and additional water was added to separate the soil particles that would pass through the sieve. The process was continued until the wash water passing through the sieve was clear. The sample was then transferred back to a container and dried at 110 (plus or minus 5) degrees Celsius. After drying, the sample was removed from the oven, allowed to cool, and placed in a nest of sieves (3 inch, 1-1/2 inch, 3/4 inch, 3/8 inch, No. 4, No. 8, No. 10, No. 16, No. 30, No. 50, No. 100, and No. 200). The nest of sieves was manually or mechanically shaken until less than 1 percent (by mass) of the residue on a sieve passed through that sieve during 1 minute of shaking. Each size fraction was weighed and recorded, and cumulative total weights were calculated. The test data were entered into a computer program that calculated and plotted the final results. These plotted results are included in this appendix.



SOLEA
TESTING
GROUP

Transmittal/Memorandum

RECEIVED

DEC 17 '93

**HARDING LAWSON
ASSOCIATES**

To: **Harding Lawson Associates**
105 Digital Drive
Novato, CA 94949

Attn: Brent Dostert

From: Ms. Farideh Faraji, Technical Director
Date: December 15, 1993
Subject: Laboratory Test Results; Fort Ord Site 3, HLA Project #23366.02521
STG No.: HLA.002
LRN: 4405

Remarks: Enclosed are the final test results for the subject project. Samples were submitted to our Laboratory December 10, 1993. These tests have been performed in general accordance with accepted standards and checked with STG's Quality Assurance Plan. This transmittal includes the following test(s):

Item	Description	Quantity
1	Sieve Analysis to #200 Sieve	22

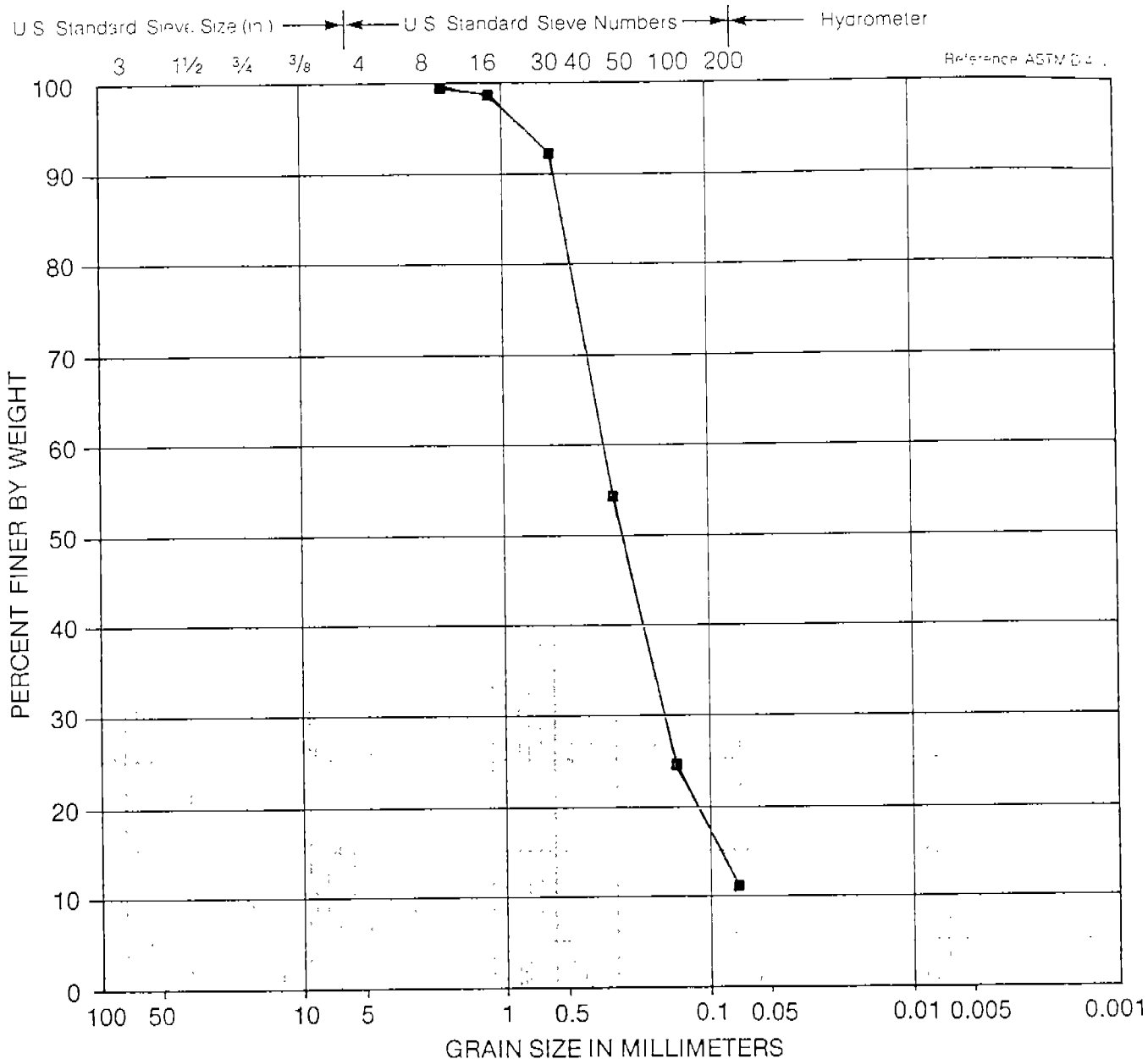
Untested samples, portions of tested samples, when available, and sample tubes will be held for a period of 8 weeks. Samples and tubes will be discarded at that time unless other arrangements are made. Sample storage fees will be charged for storage periods greater than 8 weeks. STG does not store contaminated samples and by-products produced from testing. These will be returned to you.

If you have any questions, please call me at (510) 682-7005. Thank you.

Ms. Farideh Faraji, Technical Director

Thomas Davise, CEO

cc:



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 1/D-1 @ 25.0 FT	BROWN SILTY SAND (SM)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA 2-4405

APPROVED

FF

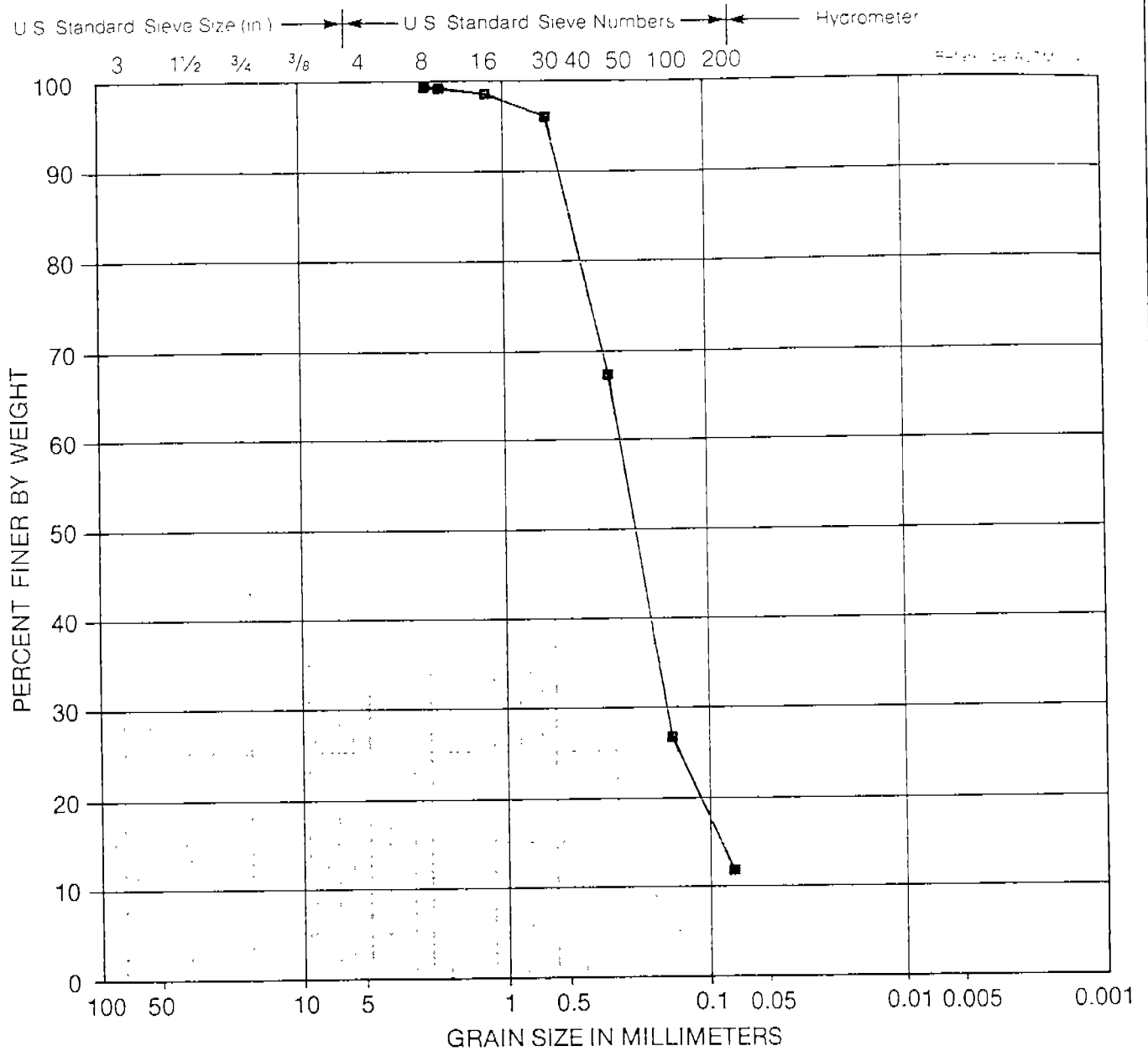
DATE

12-15-1993

REVISED

DATE

PLATE



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 1/M-2 @ 25.0 FT	BROWN SILTY SAND (SM)

Particle Size Analysis

SOLEA

SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA.2-4405

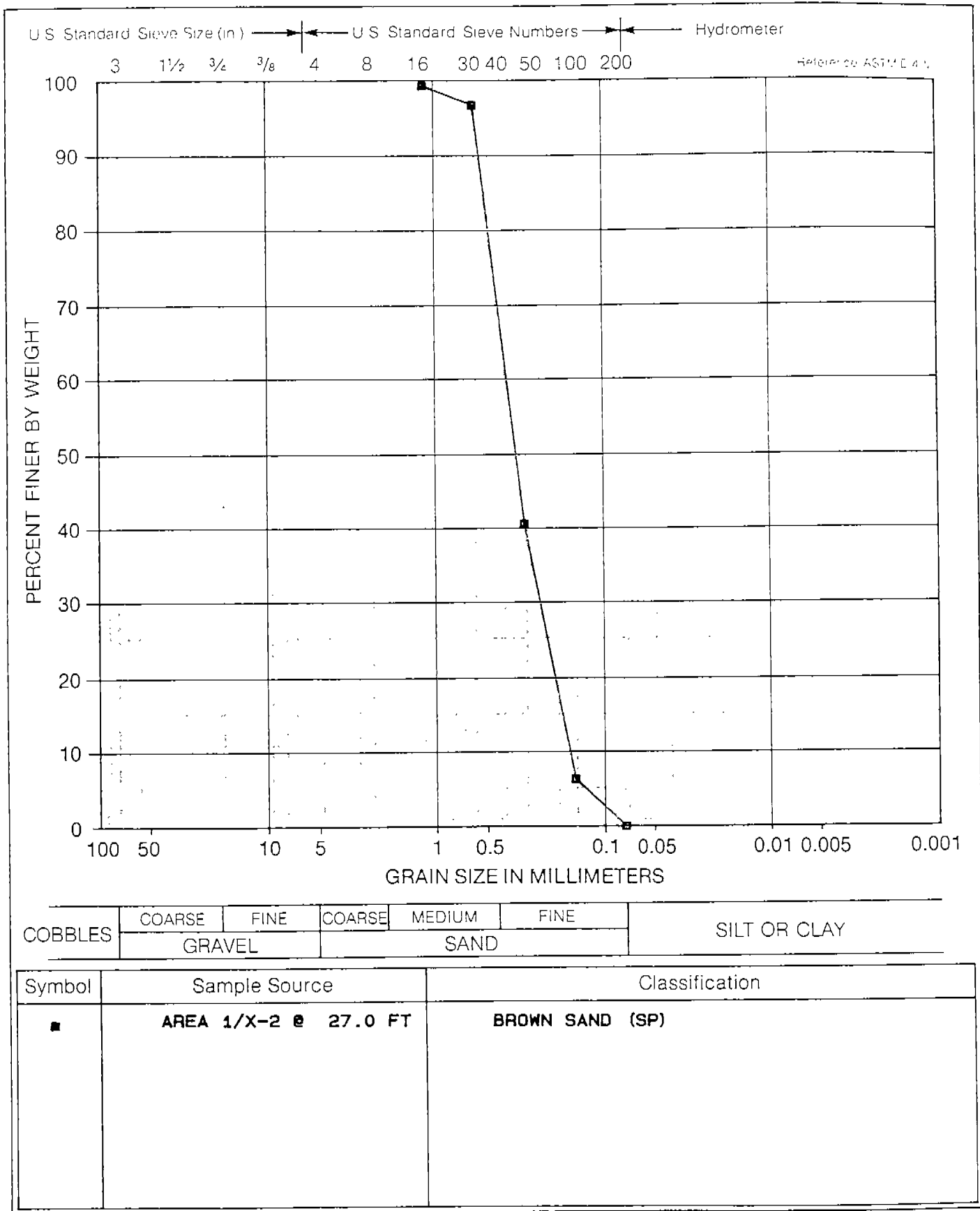
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DATE

REV. SEC

12-15-1993



Particle Size Analysis



DRAWN

JOB NUMBER

APPROVED

DATE

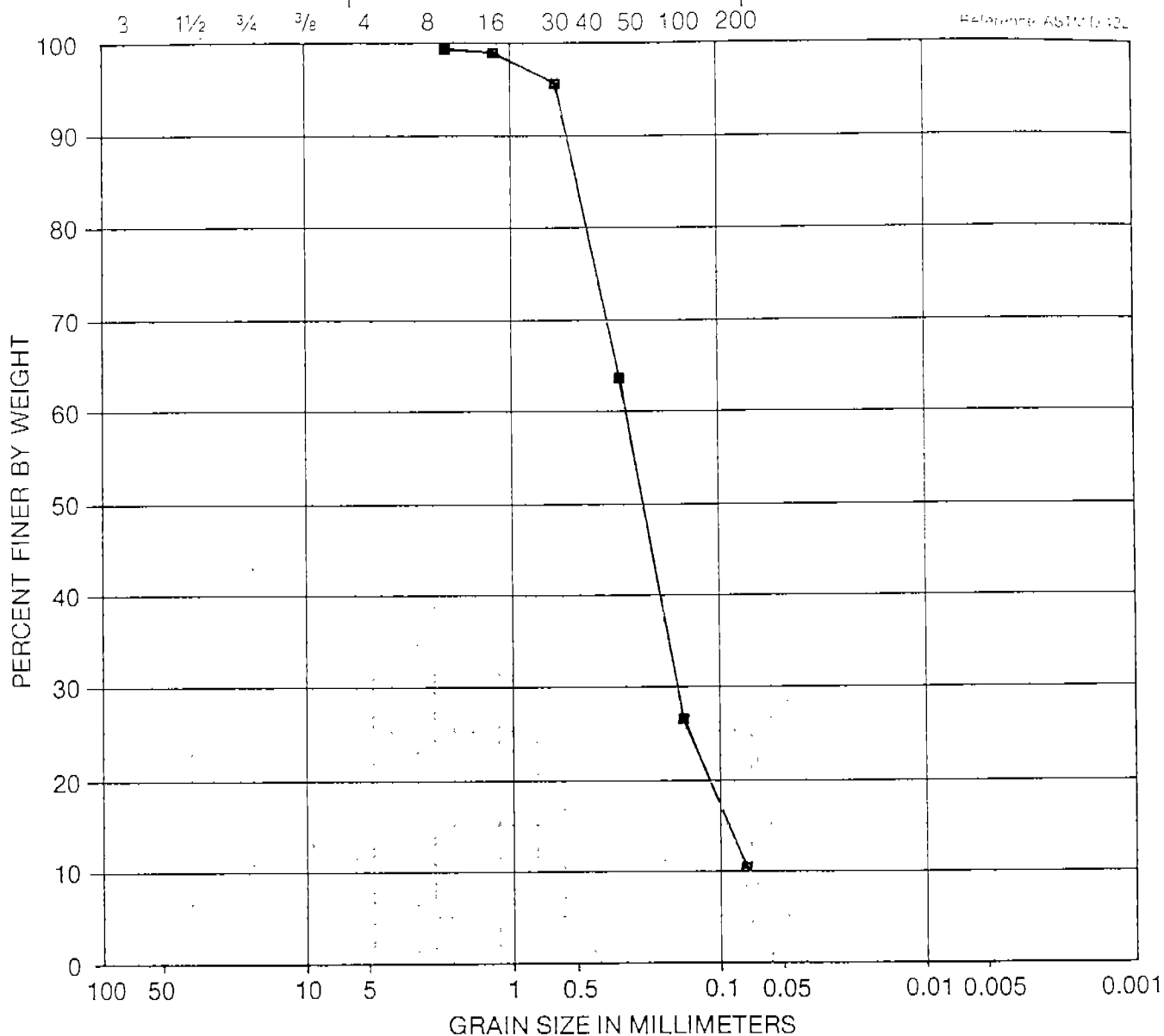
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CAD

HLA. 2-4405

12-15-1993

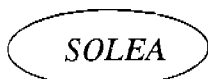
U.S. Standard Sieve Size (in.) ———— U.S. Standard Sieve Numbers ———— Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 1/V-6 @ 28.0 FT	BROWN SAND W/SILT (SP-SM)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA.2-4405

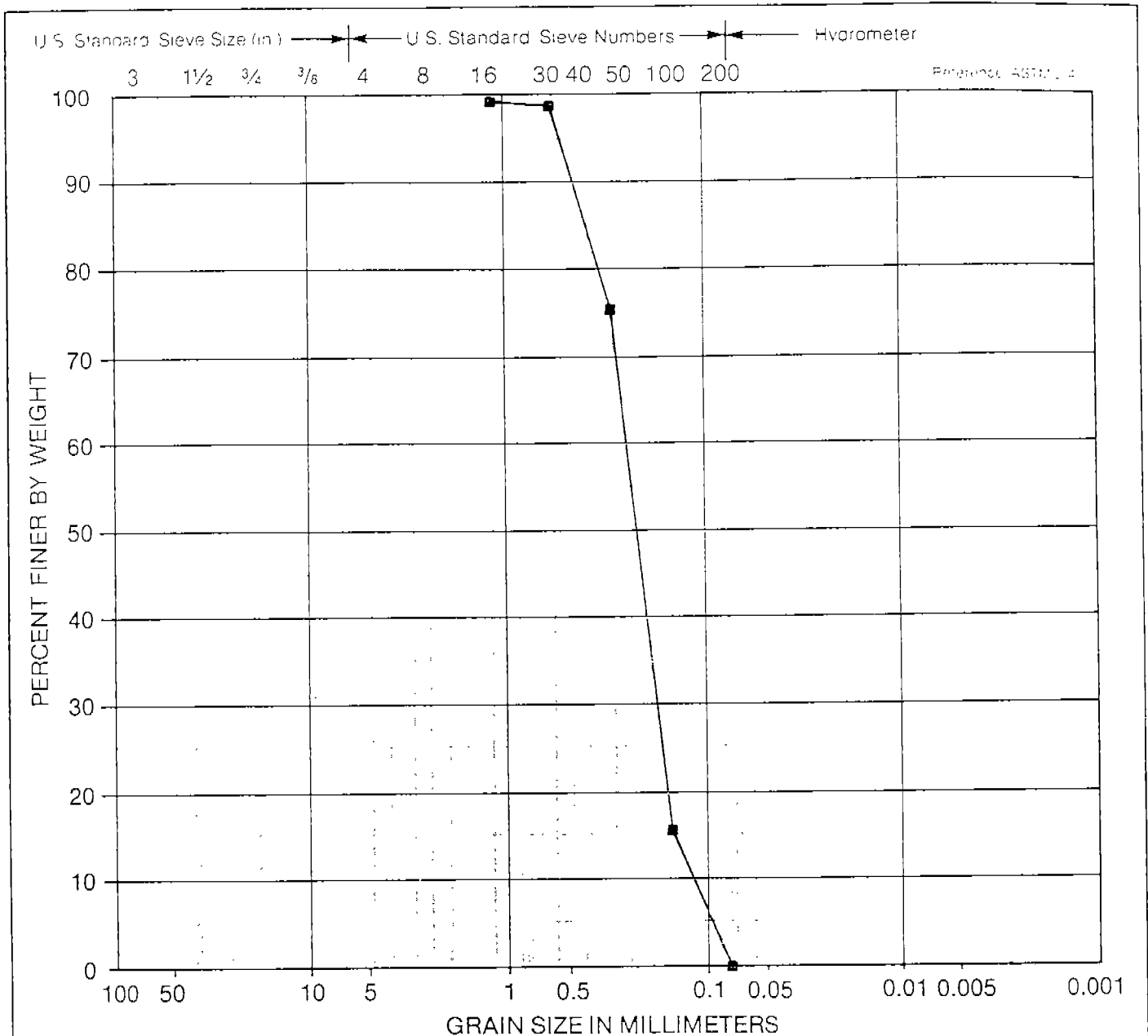
APPROVED

DATE

12-15-1993

REVISED

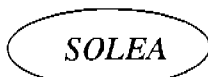
BY



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 1/K-4 @ 29.0 FT	BROWN SAND (SP)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA.2-4405

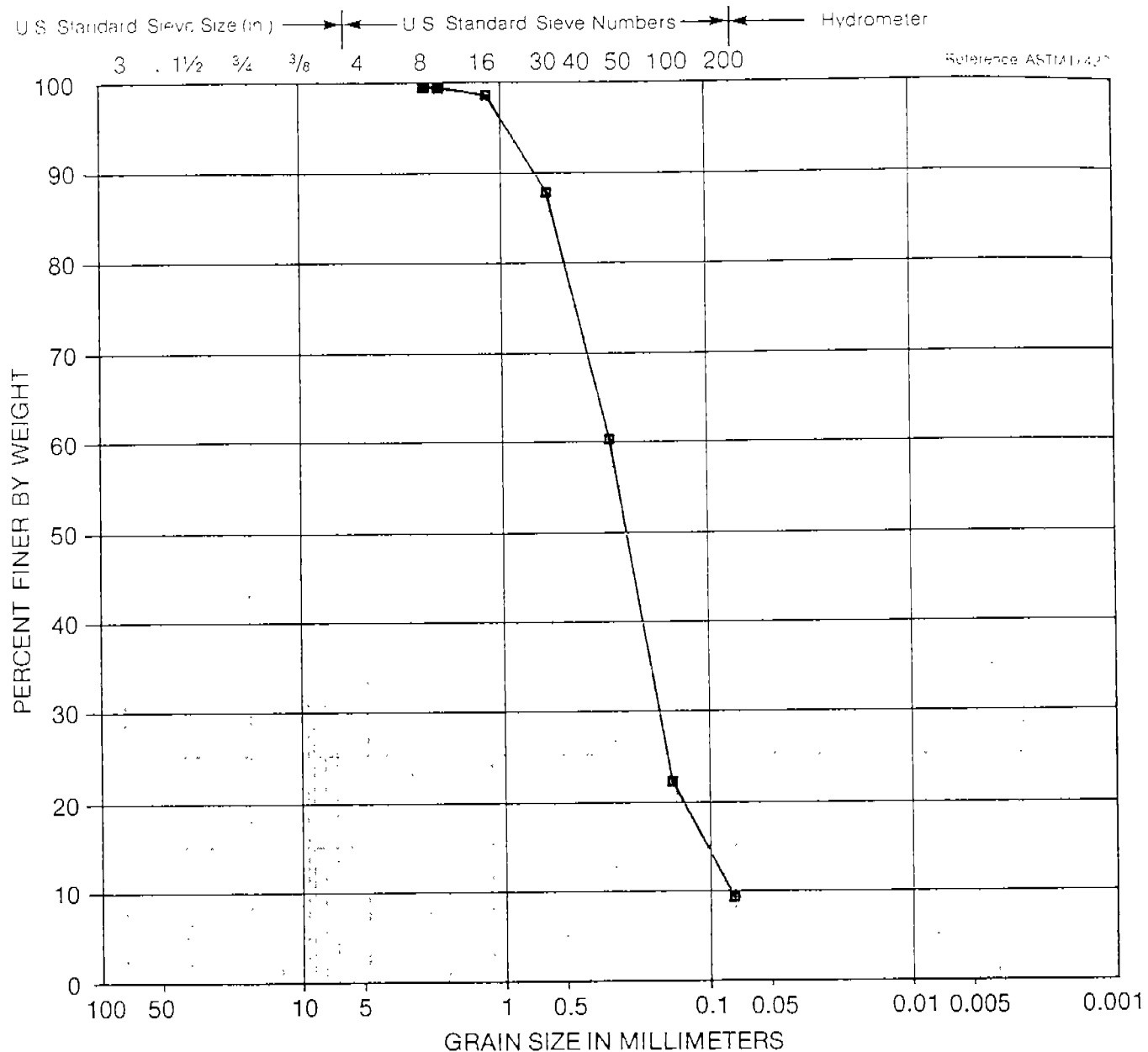
APPROVED

DATE

12-15-1993

BY

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COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 2/S19 @ 13.0 FT	BROWN SAND W/SILT (SP-SM)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA.2-4405

APPROVED

DATE

12-15-1993

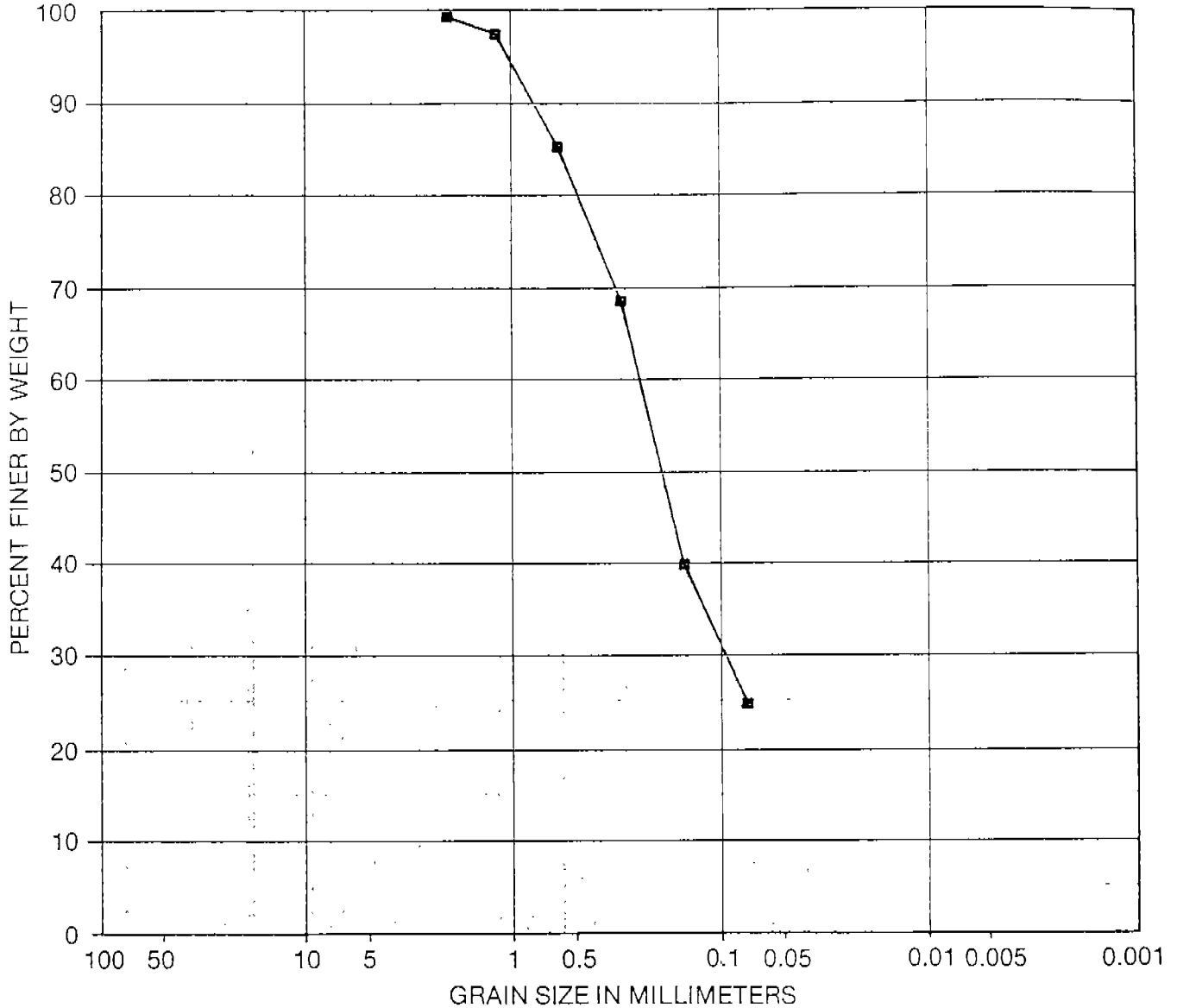
REVISED

DATE

U.S. Standard Sieve Size (in.) ——— U.S. Standard Sieve Numbers ——— Hydrometer

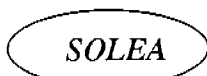
3 1½ ¾ ⅝ 4 8 16 30 40 50 100 200

Revised by ASTM D422



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 2/E35 @ 14.0 FT	BROWN SILTY SAND (SM)

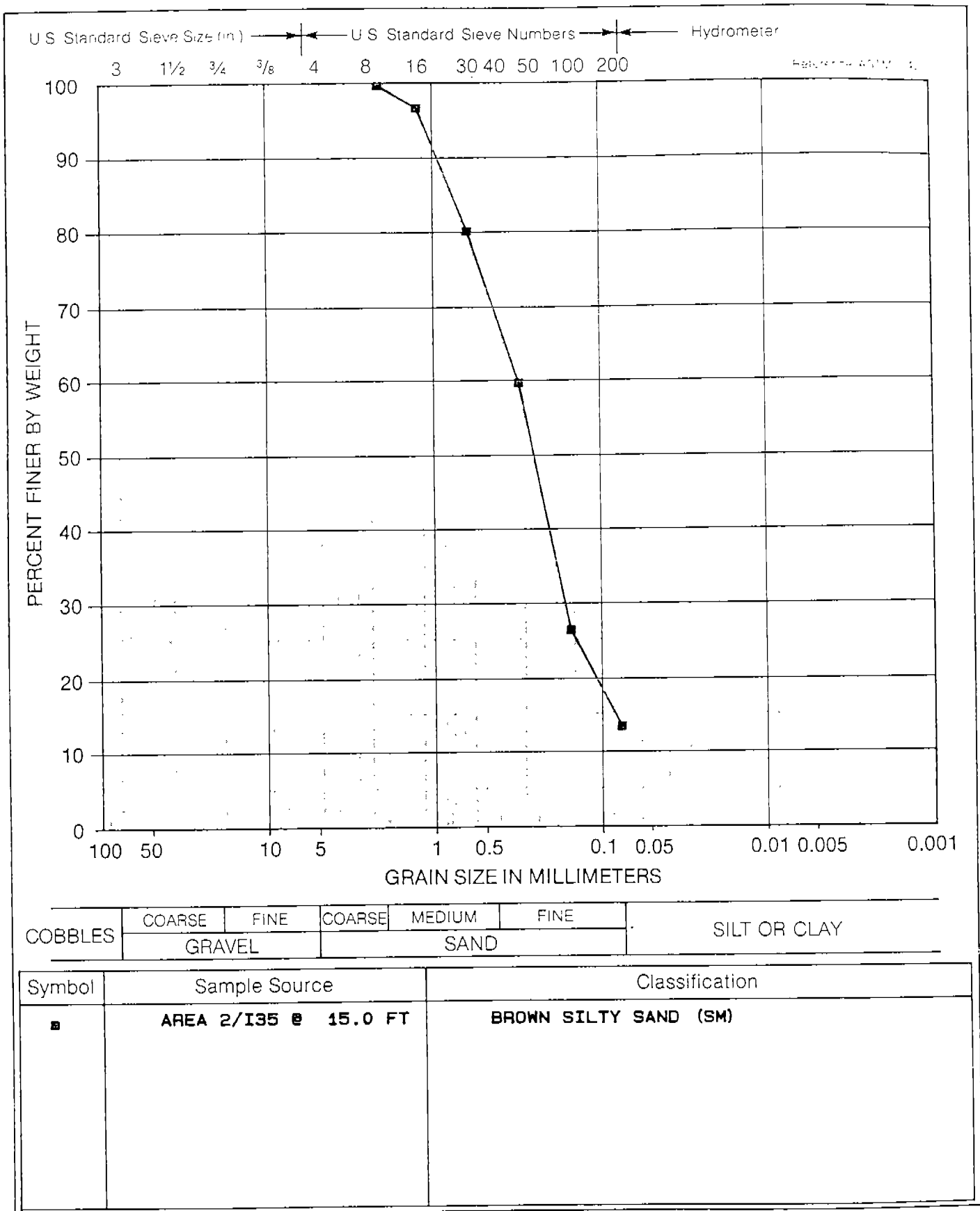


SOLEA TESTING GROUP

Particle Size Analysis

PLATE

DRAWN: HLA.2-4405 JOB NUMBER: 12-15-1993 APPROVED: DATE: REVISED: DATE:



Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER
HLA.2-4405

APPROVED

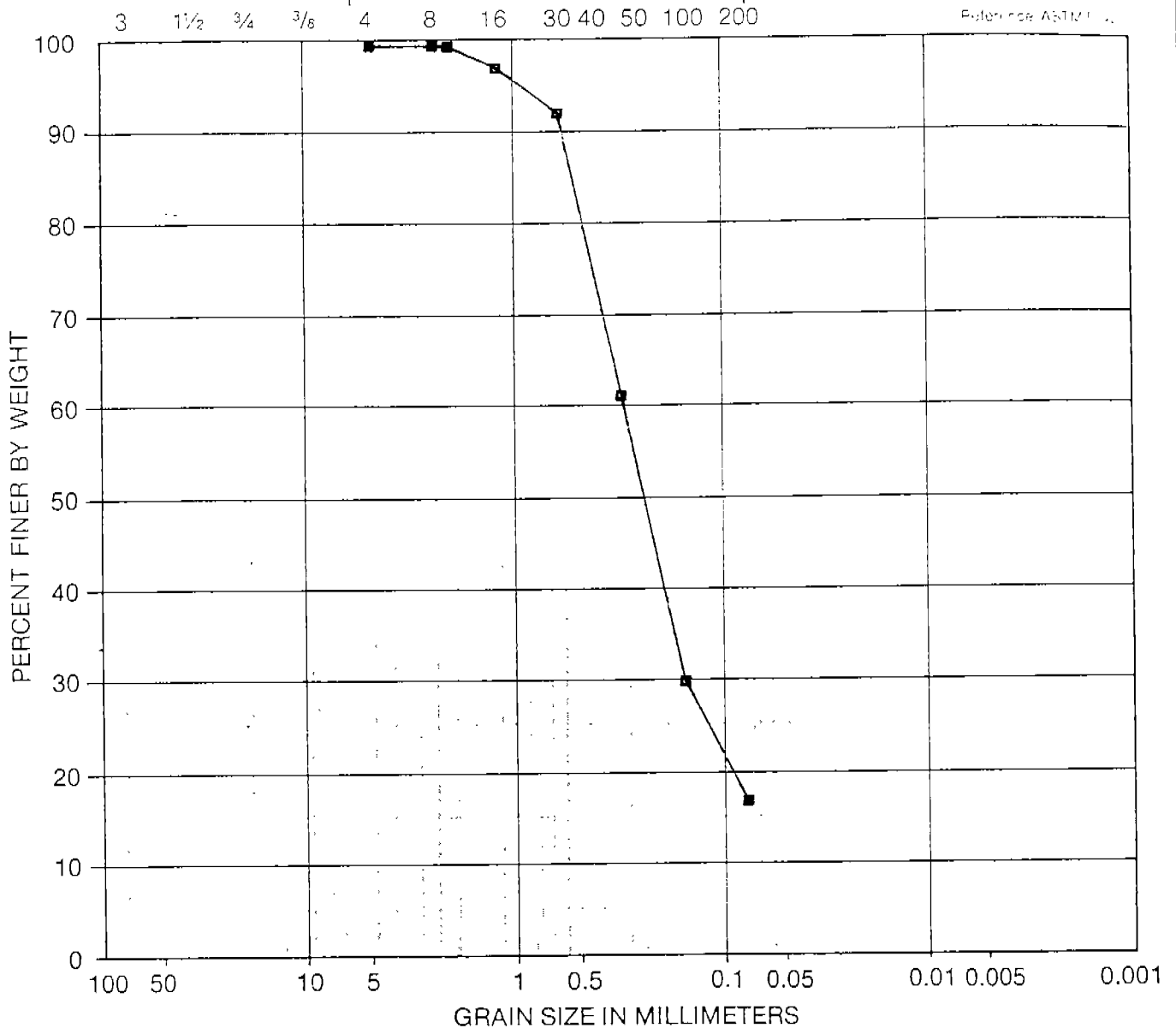
DATE

BY

DATE

12-15-1993

U.S. Standard Sieve Size (in.) U.S. Standard Sieve Numbers Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 1/D-9 @ 30.0 FT	BROWN SILTY SAND (SM)

Particle Size Analysis



DRAWN

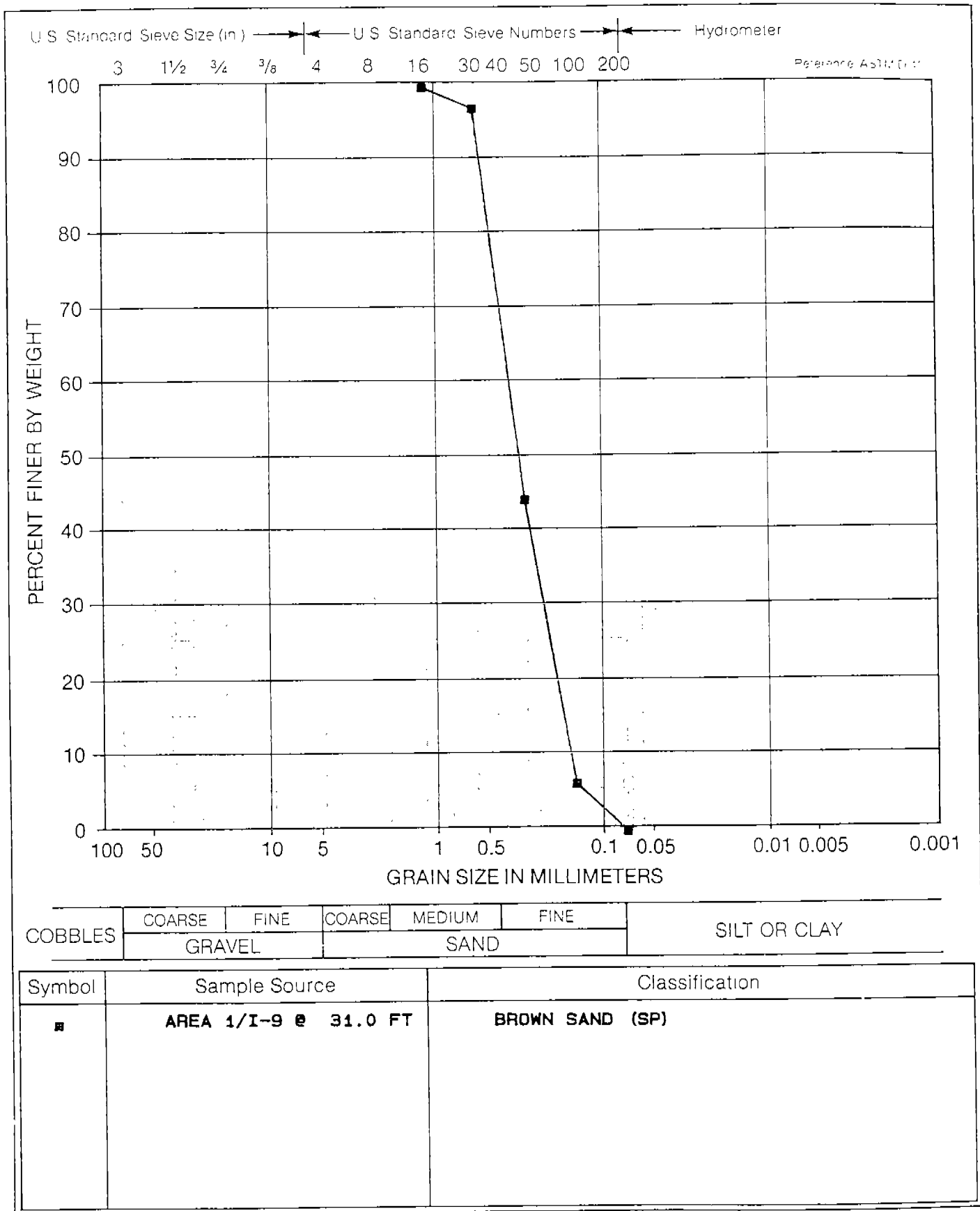
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HLA.2-4405

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DATE
12-15-1993

BY

DATE



Particle Size Analysis



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JOB NUMBER
HLA.2-4405

APPROVED

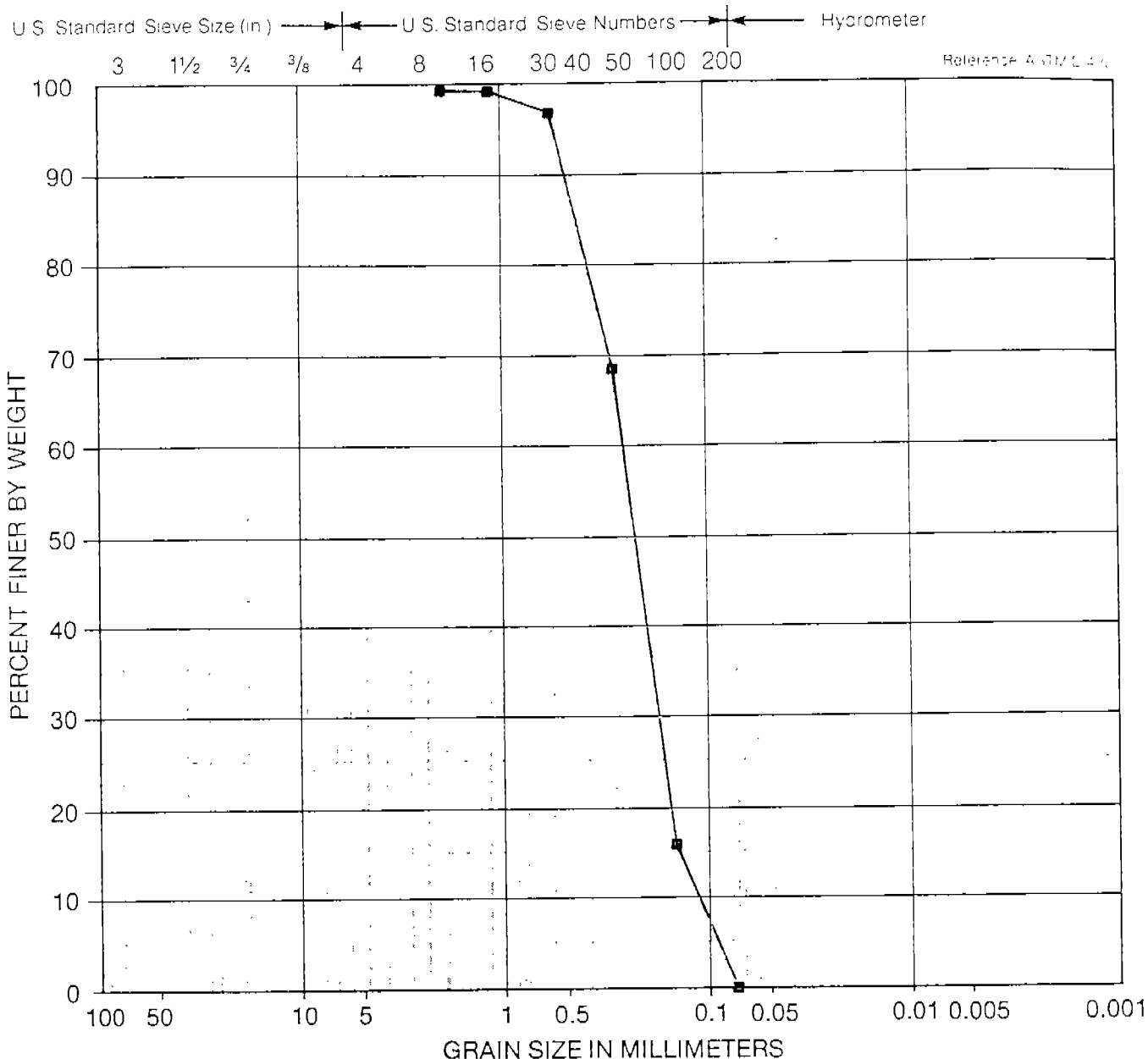
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DATE

12-15-1993

REVISED

DATE



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 1/K13 @ 32.0 FT	BROWN SAND (SP)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA 2-4405

APPROVED

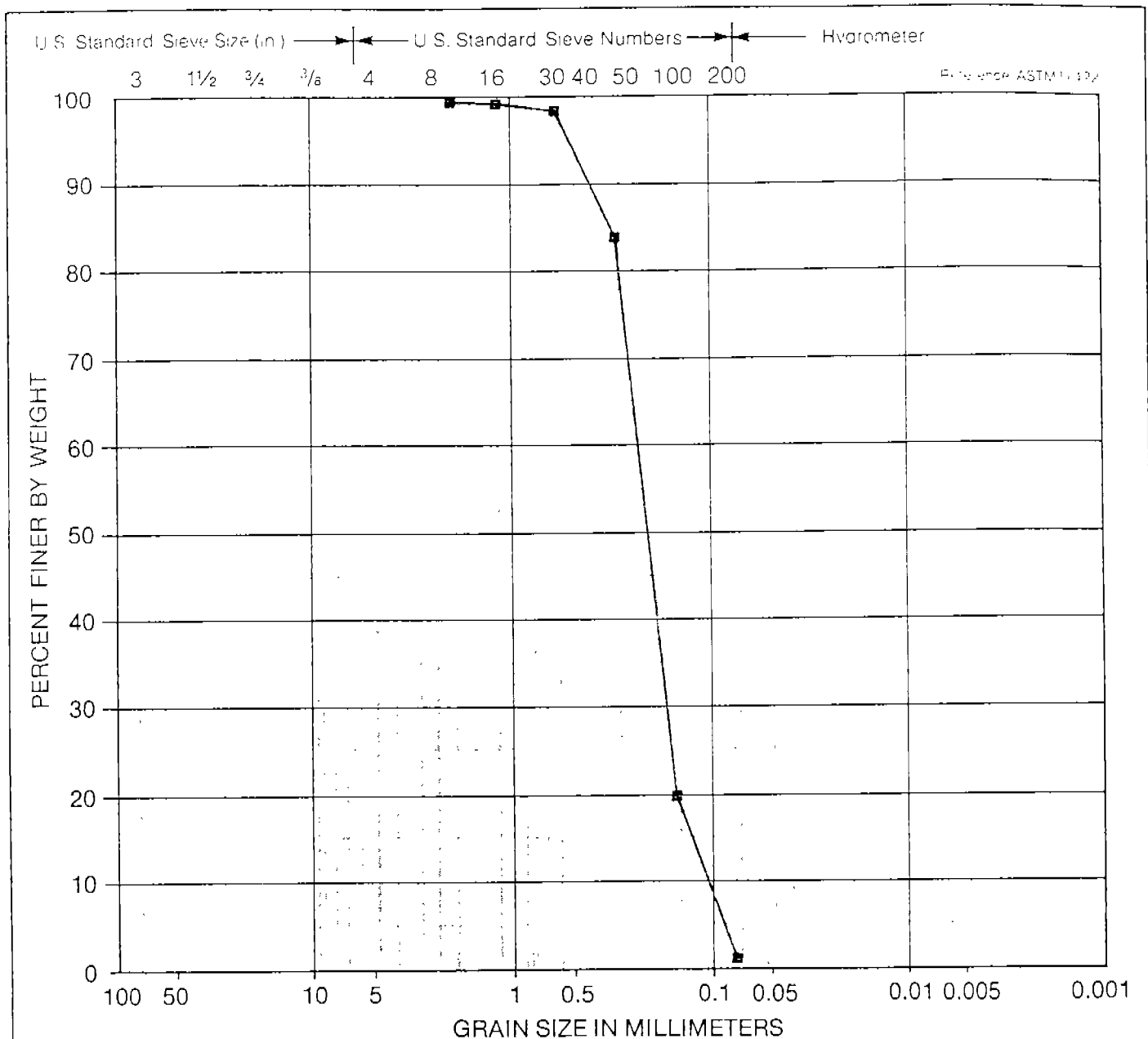
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DATE

12-15-1993

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COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 1/E15 @ 33.0 FT	BROWN SAND (SP)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA.2-4405

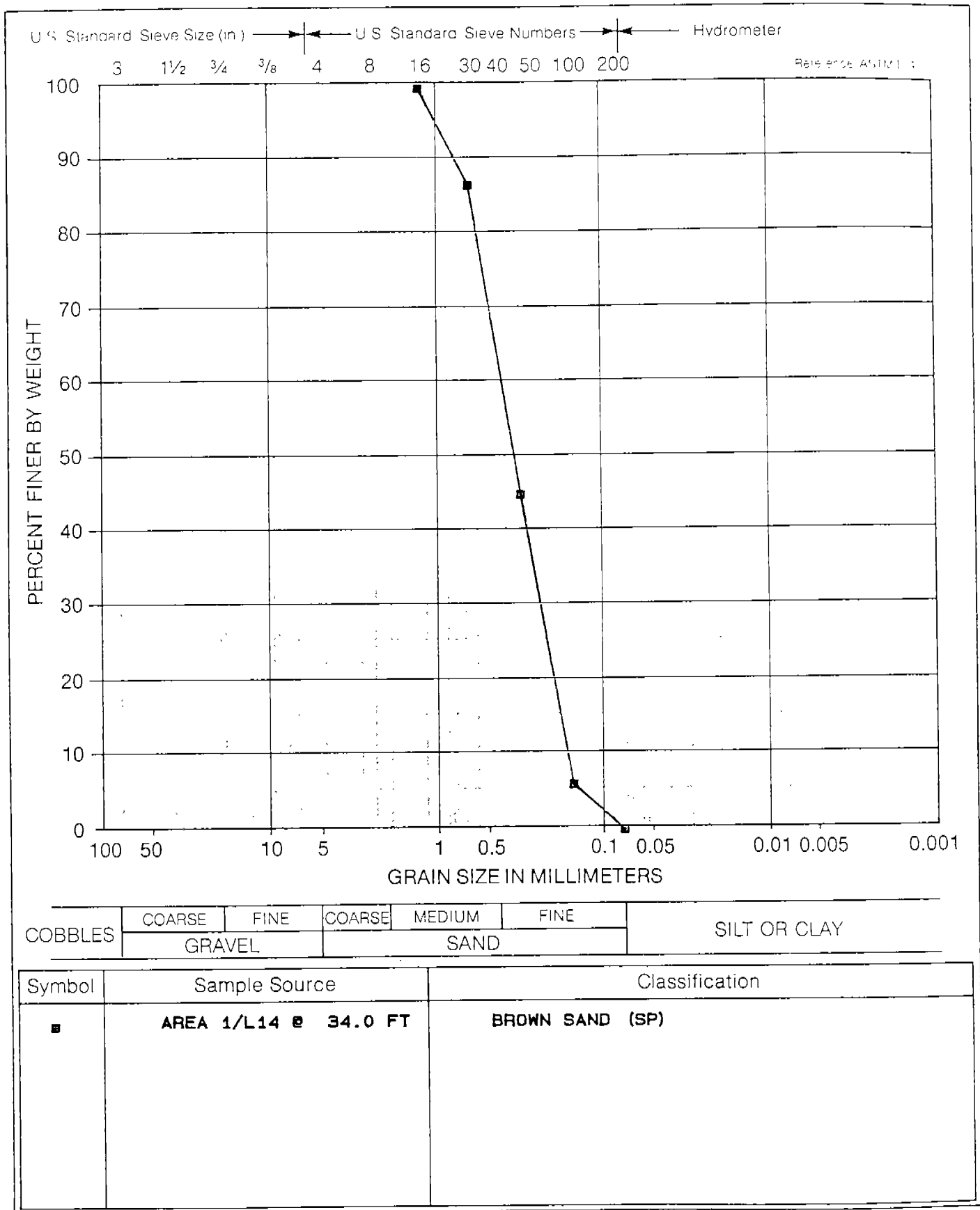
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12-15-1993

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DATE



Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA 2-4405

APPROVED

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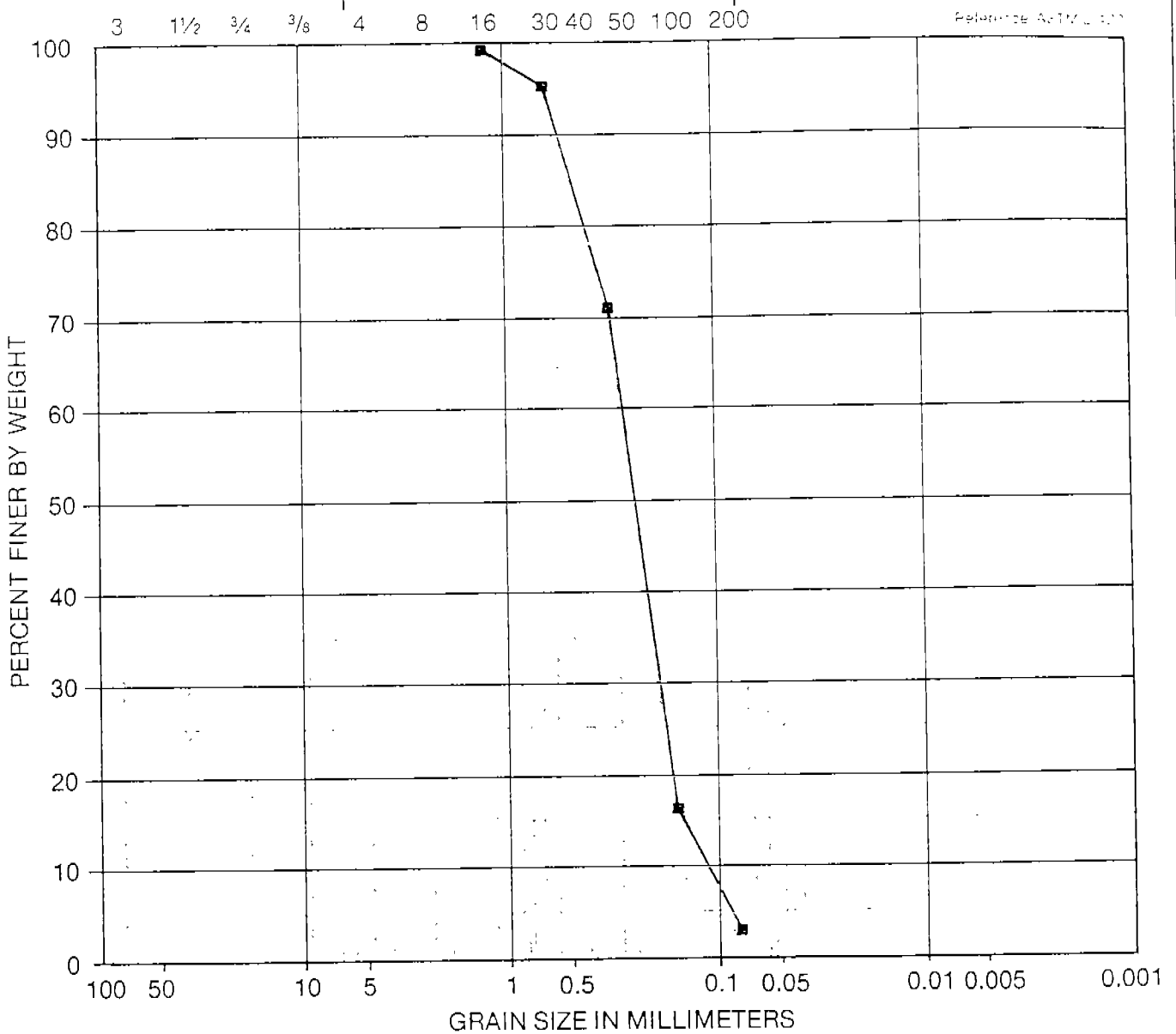
DATE

12-15-1993

REVISED

101

U.S. Standard Sieve Size (in.) ——— U.S. Standard Sieve Numbers ——— Hydrometer



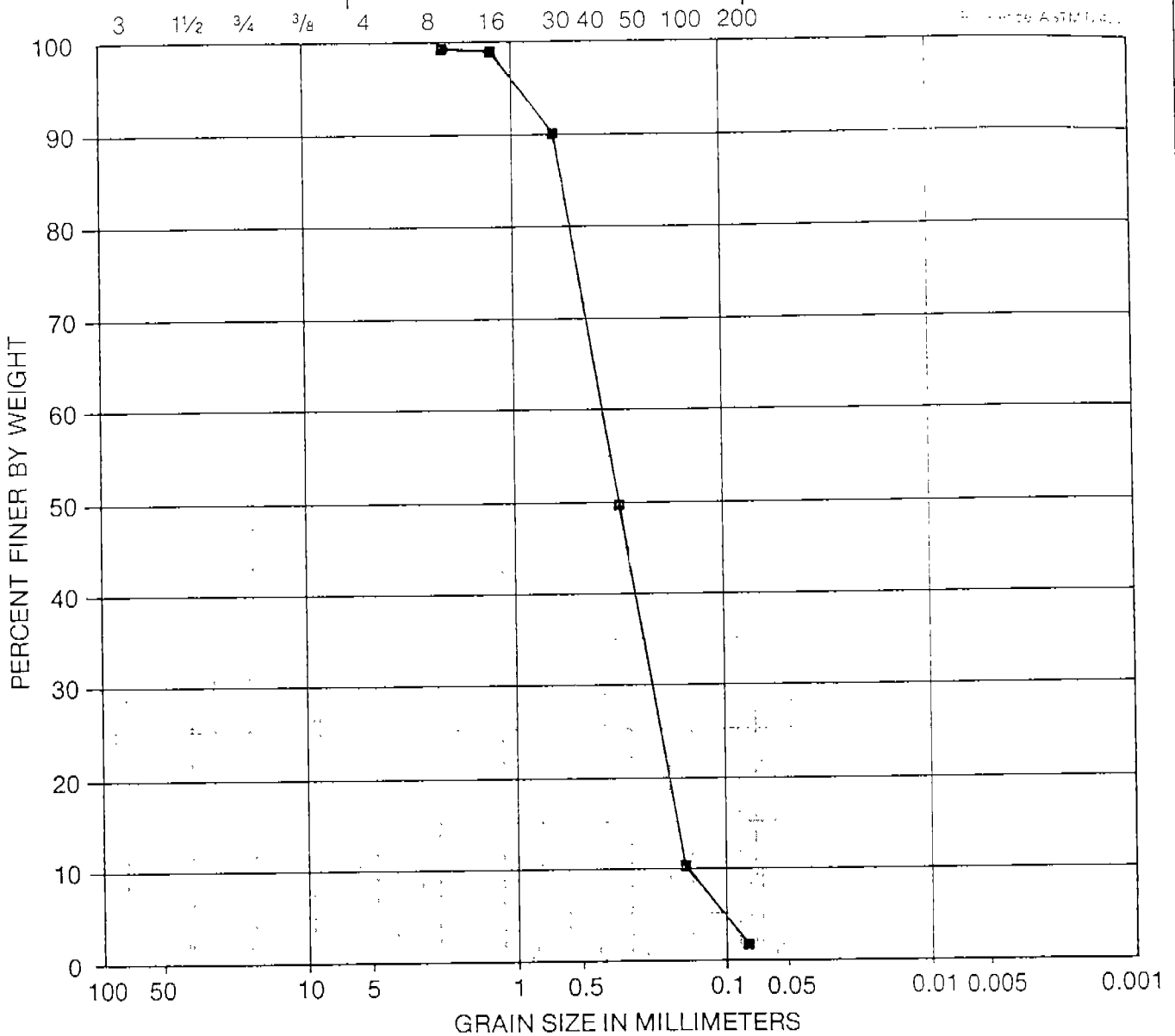
COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 2/G37 @ 16.0 FT	BROWN SAND (SP)

Particle Size Analysis



U.S. Standard Sieve Size (in.) U.S. Standard Sieve Numbers Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 2/M38 @ 17.0 FT	BROWN SAND (SP)

Particle Size Analysis



DRAWN

JOB NUMBER

APPROVED

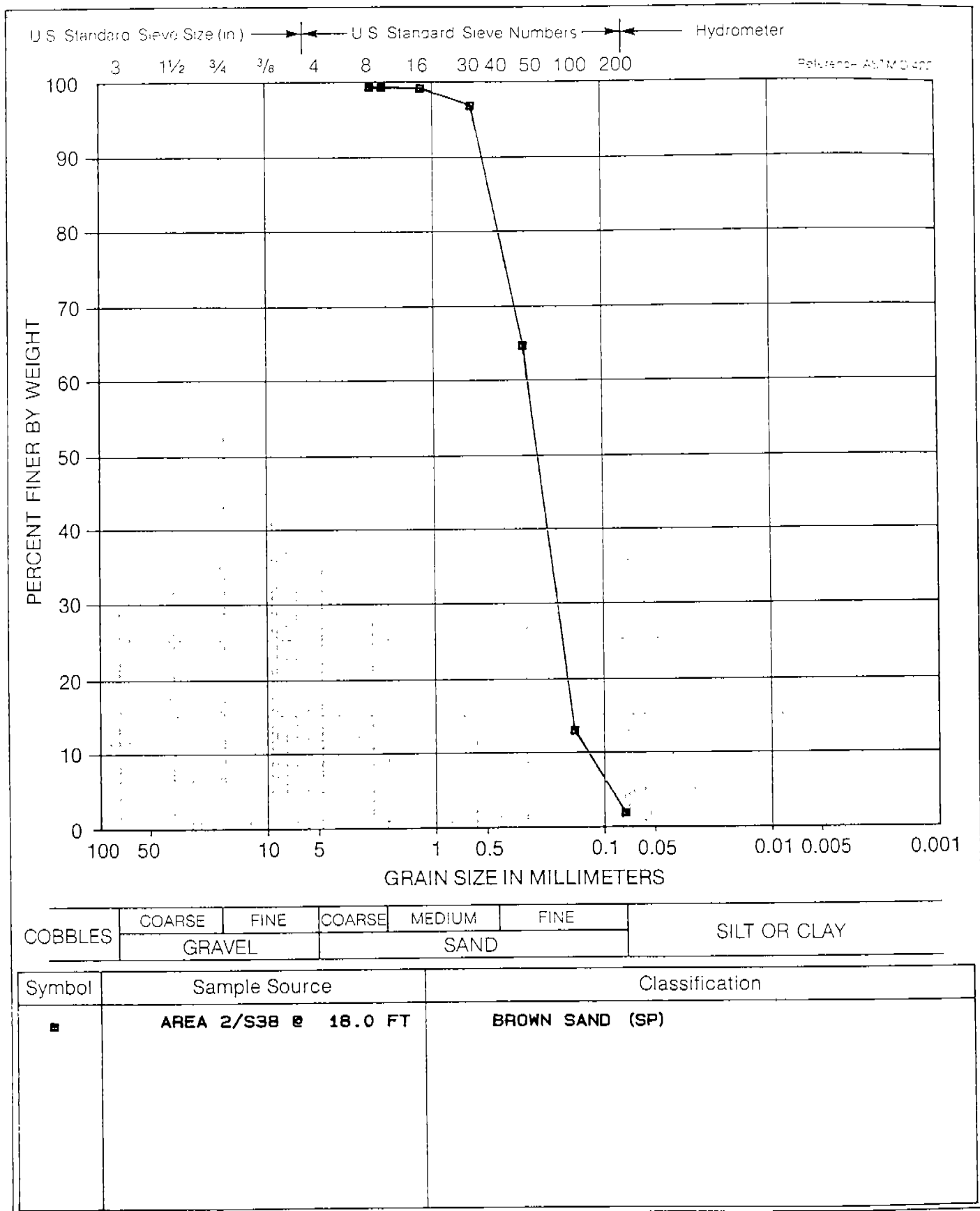
DATE

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DATE

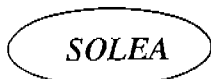
HLA. 2-4405

12-15-1993



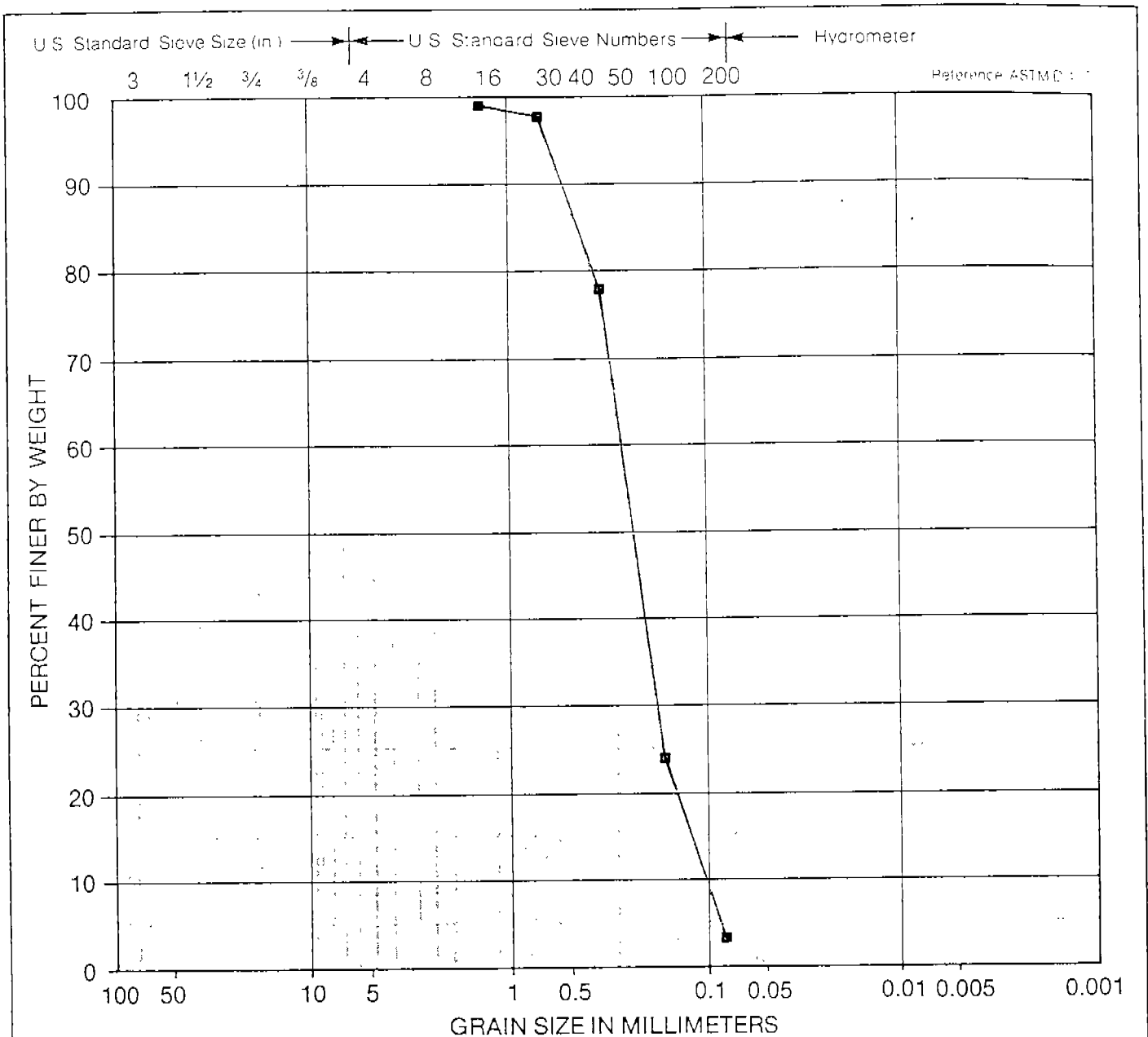
Particle Size Analysis

PLATE



SOLEA TESTING GROUP

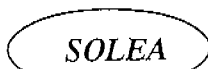
DRAWN	JOB NUMBER	APPROVED	DATE	REVIEW	DATE
	HLA.2-4405	FF	12-15-1993		



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 2/C39 @ 19.0 FT	BROWN SAND (SP)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

APPROVED

DATE

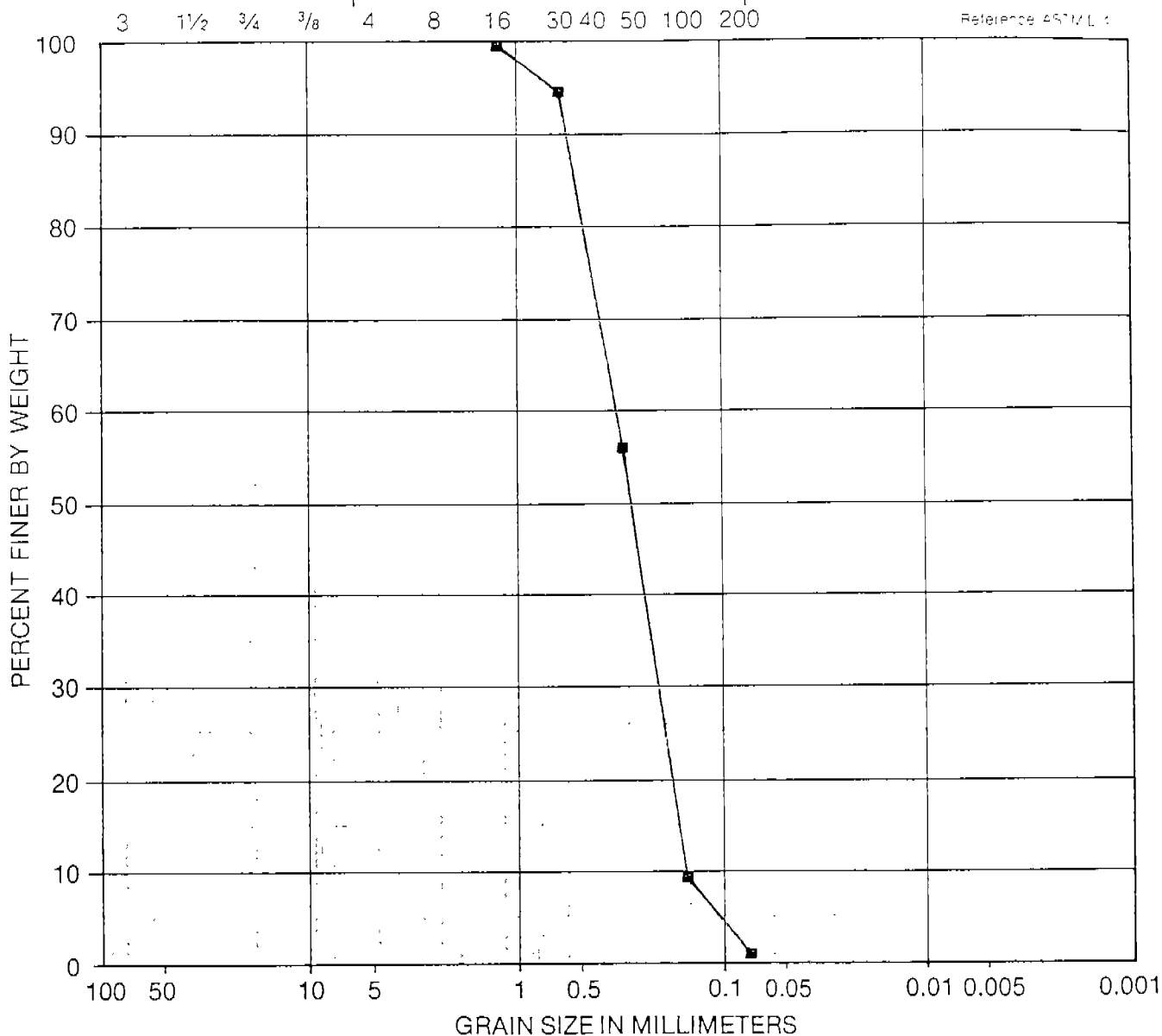
REVISED

DATE

HLA 2-4405

12-15-1993

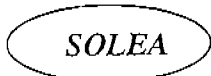
U.S. Standard Sieve Size (in) ———> U.S. Standard Sieve Numbers ———> Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 2/M-4 @ 20.0 FT	BROWN SAND (SP)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA. 2-4405

APPROVED

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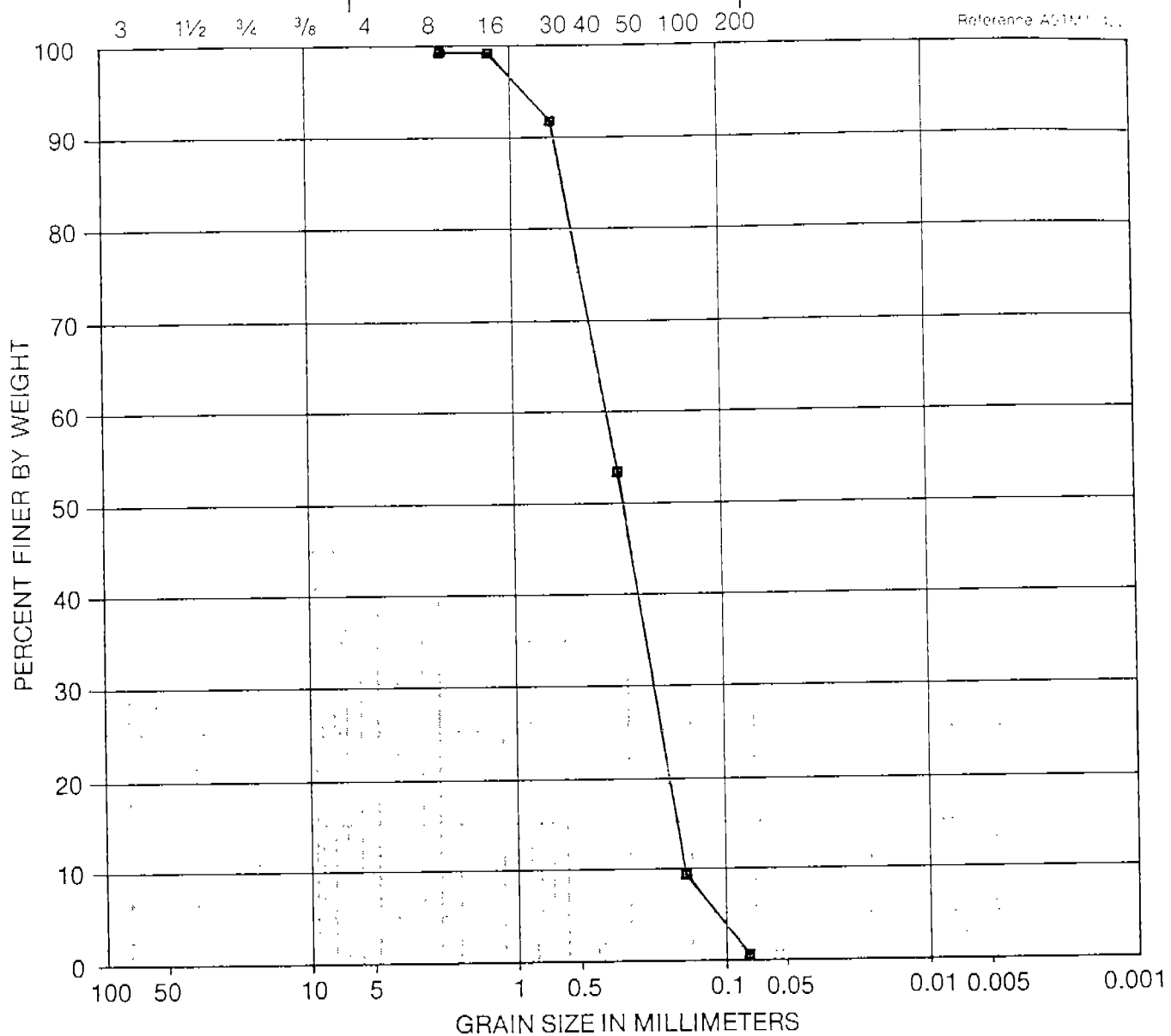
DATE

12-15-1993

REVIEWED

DATE

U S Standard Sieve Size (in) U S Standard Sieve Numbers Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	AREA 2/G43 @ 21.0 FT	BROWN SAND (SP)

Particle Size Analysis

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SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA 2-4405

APPROVED

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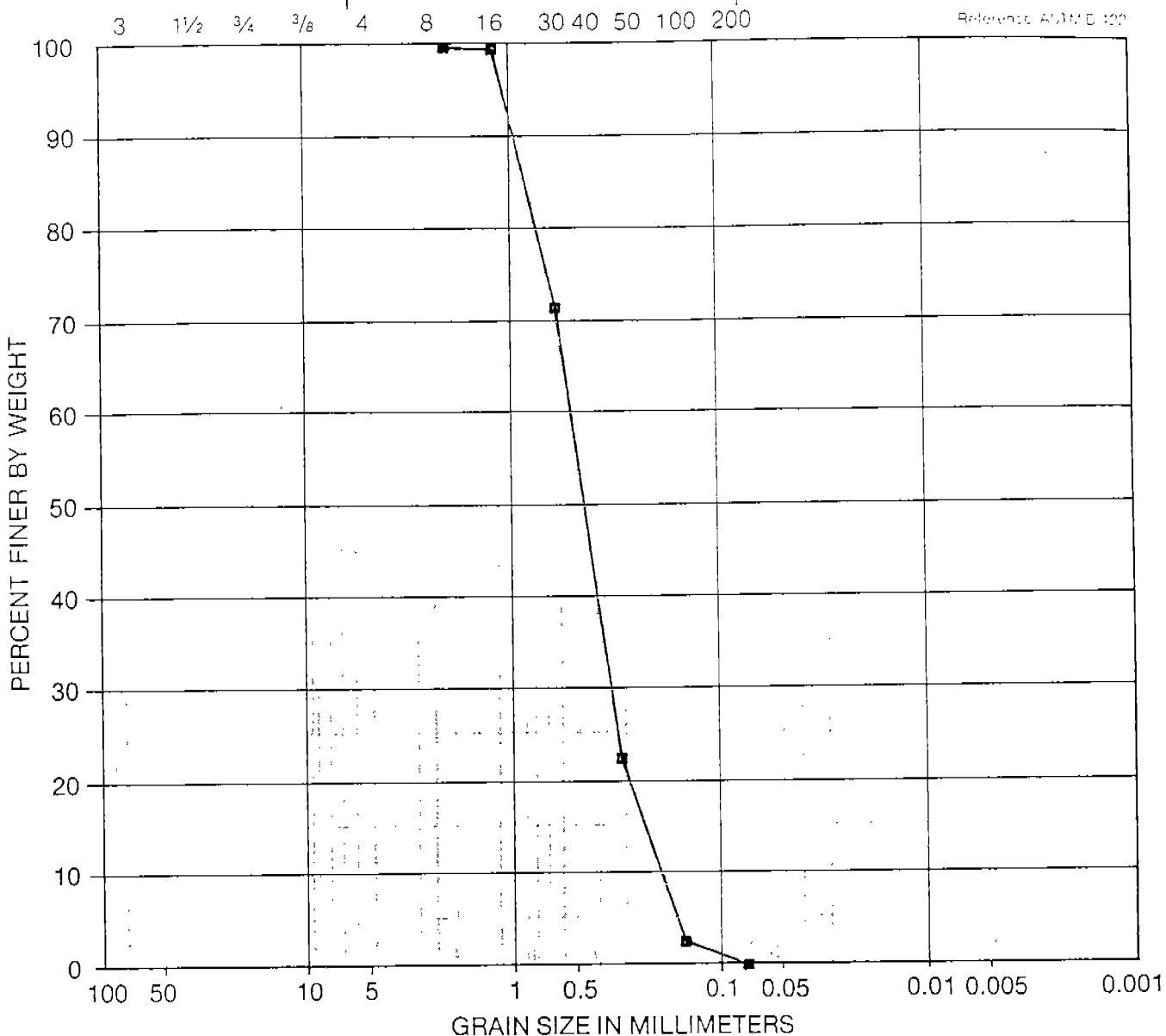
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12-15-1993

REVISED

DATE

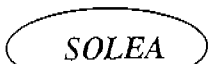
U.S. Standard Sieve Size (in.) ——— U.S. Standard Sieve Numbers ——— Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	C AREA/A31 @ 23.0 FT	BROWN SAND (SP)

Particle Size Analysis



SOLEA TESTING GROUP

DRAWN

JOB NUMBER

HLA.2-4405

APPROVED

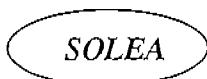
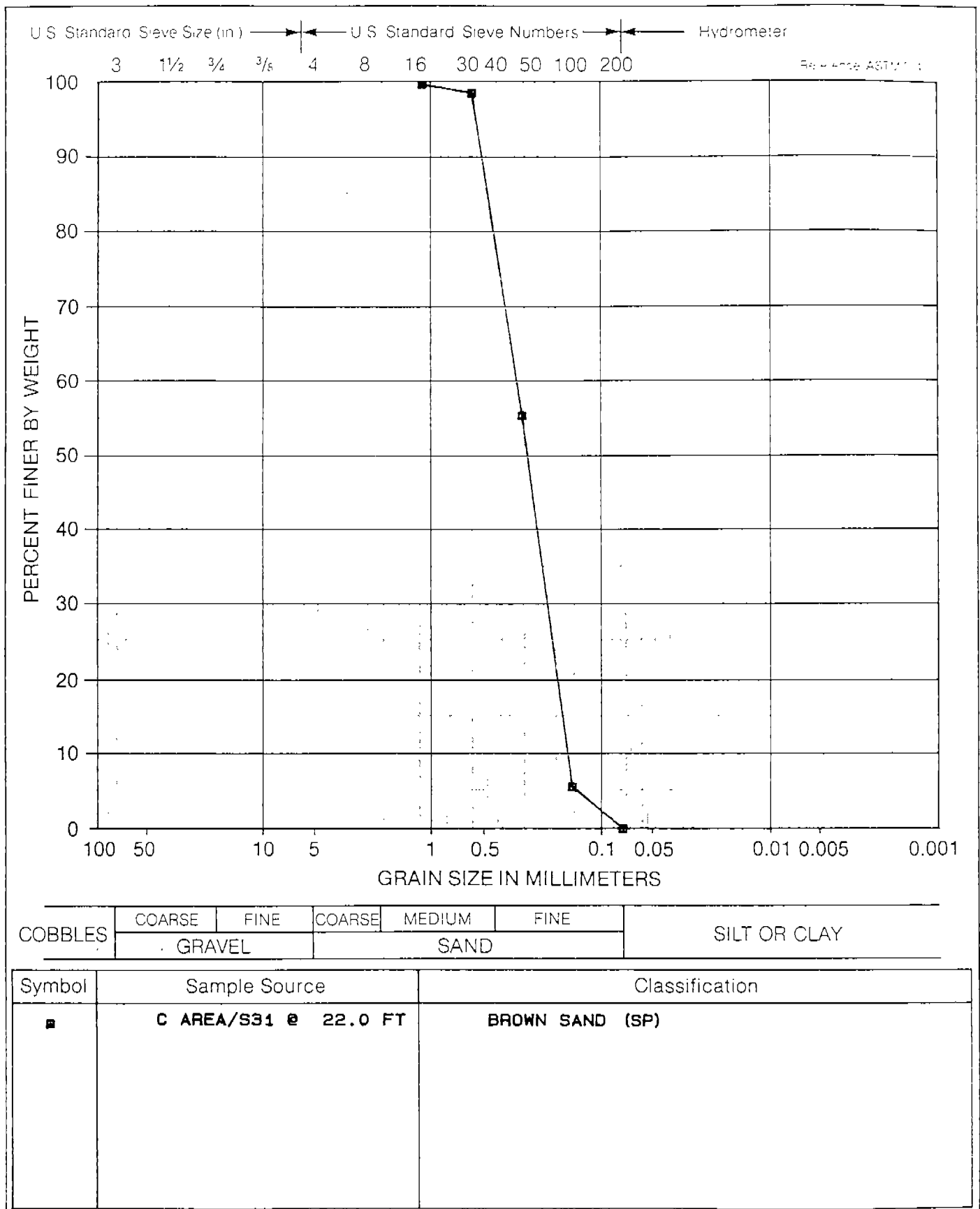
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12-15-1993

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DATE



SOLEA TESTING GROUP

Particle Size Analysis

DRAWN

JOB NUMBER
HLA-2-4405

APPROVED

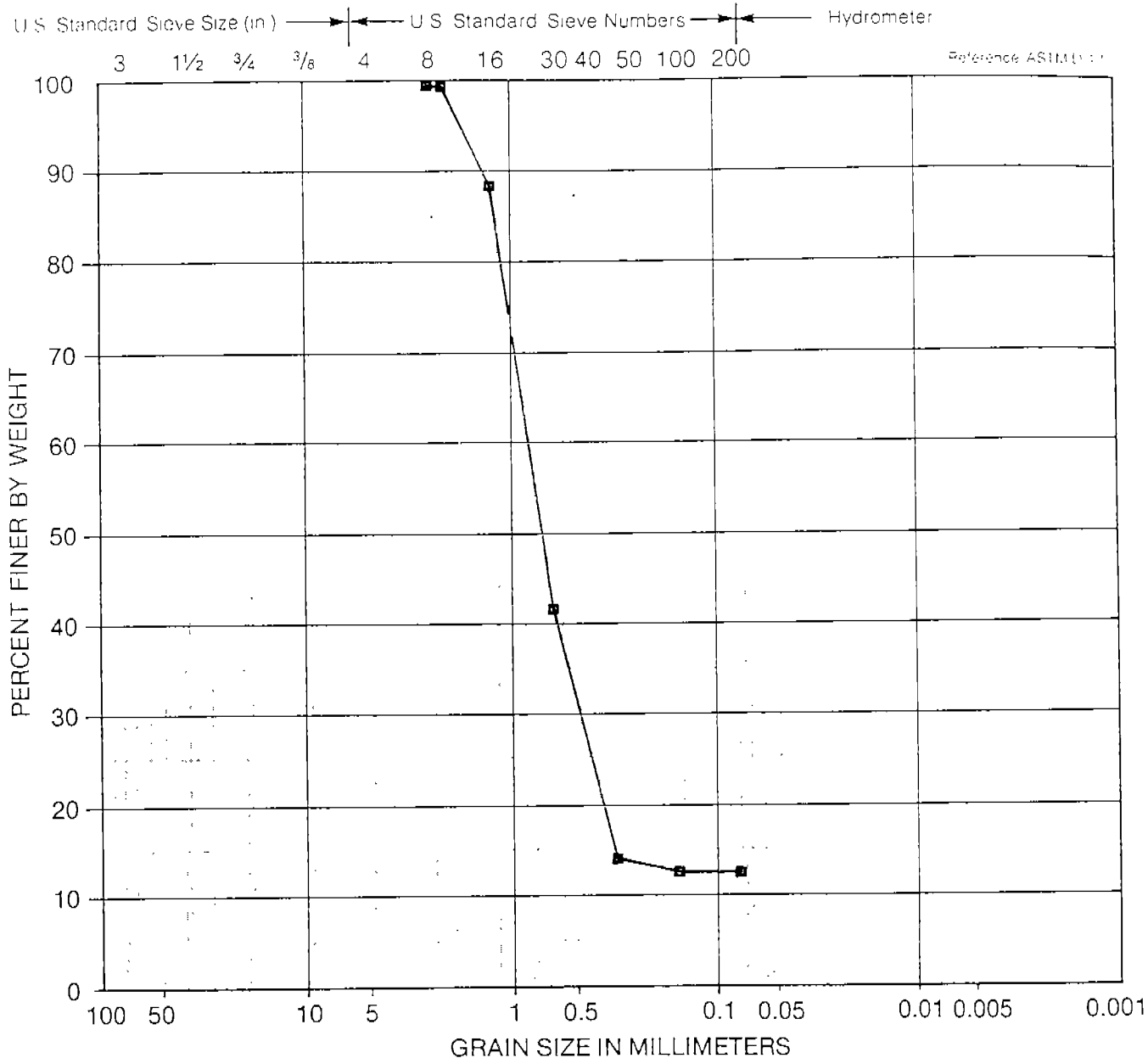
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DATE

12-15-1993

REVISED

BY



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	C AREA @ 24.0 FT	BROWN SILTY SAND (SM)

Particle Size Analysis



DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	HLA.2-4405	FP	12-15-1993		

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/V-6 @ 28.0

Total Sample Weight (g): 269.5
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2763

Sand : 88.5

@ 30% Passing : 0.1572

Fines : 11.5

@ 10% Passing : 0.0703

Coefficient of Uniformity: 3.93E 0

Coefficient of Curvature: 1.27E 0

Soil Classification: BROWN SAND W/SILT

(SP-SM*)

Frost Classification: --

Data Entry By: CLM

File #: 701

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/V-6 @ 28.0 Data File : TEST0701

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	1.0	99.6
No. 30	0.600	9.9	96.3
No. 50	0.300	96.0	64.4
No. 100	0.150	195.4	27.5
No. 200	0.075	238.5	11.5

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/K-4 @ 29.0

Total Sample Weight (g): 319.7
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2485

Sand : 98.9

@ 30% Passing : 0.1752

Fines : 1.1

@ 10% Passing : 0.1115

Coefficient of Uniformity: 2.23E 0

Coefficient of Curvature: 1.11E 0

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 702

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/K-4 @ 29.0Data File : TEST0702

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	1.6	99.5
No. 50	0.300	76.1	76.2
No. 100	0.150	266.5	16.6
No. 200	0.075	316.1	1.1

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/D-9 @ 30.0

Total Sample Weight (g): 292.9
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2880

Sand : 82.2

@ 30% Passing : 0.1438

Fines : 17.8

@ 10% Passing : 0.0497

Coefficient of Uniformity: 5.80E 0

Coefficient of Curvature: 1.45E 0

Soil Classification: BROWN SILTY SAND

(SM*)

Frost Classification: --

Data Entry By: CLM

File #: 703

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/D-9 @ 30.0 Data File : TEST0703

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.1	100.0
No. 10	2.000	0.3	99.9
No. 16	1.180	7.2	97.5
No. 30	0.600	21.5	92.7
No. 50	0.300	111.8	61.8
No. 100	0.150	202.7	30.8
No. 200	0.075	240.9	17.8

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/I-9 @ 31.0

Total Sample Weight (g): 309.5
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%) : Particle Diameter (mm) :
Gravel : 0.0 @ 60% Passing : 0.3670
Sand : 99.5 @ 30% Passing : 0.2291
Fines : 0.5 @ 10% Passing : 0.1589

Coefficient of Uniformity: 2.31E 0

Coefficient of Curvature: 9.00E-1

Soil Classification: BROWN SAND (SP)

Frost Classification: --

Data Entry By: CLM

File #: 704

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/I-9 @ 31.0Data File : TEST0704

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	8.6	97.2
No. 50	0.300	171.0	44.7
No. 100	0.150	288.3	6.8
No. 200	0.075	307.9	0.5

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/K13 @ 32.0

Total Sample Weight (g): 309.0
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2653

Sand : 98.8

@ 30% Passing : 0.1783

Fines : 1.2

@ 10% Passing : 0.1104

Coefficient of Uniformity: 2.40E 0

Coefficient of Curvature: 1.09E 0

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 705

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/K13 @ 32.0 Data File : TEST0705

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.2	99.9
No. 30	0.600	7.5	97.6
No. 50	0.300	94.9	69.3
No. 100	0.150	256.6	17.0
No. 200	0.075	305.2	1.2

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/E15 @ 33.0

Total Sample Weight (g): 272.0
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2300

Sand : 97.7

@ 30% Passing : 0.1660

Fines : 2.3

@ 10% Passing : 0.1003

Coefficient of Uniformity: 2.29E 0

Coefficient of Curvature: 1.19E 0

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 706

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/E15 @ 33.0 Data File : TEST0706

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.5	99.8
No. 30	0.600	2.6	99.0
No. 50	0.300	42.2	84.5
No. 100	0.150	215.8	20.7
No. 200	0.075	265.8	2.3

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/L14 @ 34.0

Total Sample Weight (g): 276.1
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.3820

Sand : 99.2

@ 30% Passing : 0.2272

Fines : 0.8

@ 10% Passing : 0.1589

Coefficient of Uniformity: 2.40E 0

Coefficient of Curvature: 8.50E-1

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 707

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/L14 @ 34.0 Data File : TEST0707

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	36.0	87.0
No. 50	0.300	150.3	45.6
No. 100	0.150	257.4	6.8
No. 200	0.075	274.0	0.8

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/S19 @ 13.0

Total Sample Weight (g): 243.6
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2950

Sand : 89.7

@ 30% Passing : 0.1704

Fines : 10.3

@ 10% Passing : 0.0739

Coefficient of Uniformity: 3.99E 0

Coefficient of Curvature: 1.33E 0

Soil Classification: BROWN SAND W/SILT

(SP-SM*)

Frost Classification: --

Data Entry By: CLM

File #: 708

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/S19 @ 13.0Data File : TEST0708

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.2	99.9
No. 16	1.180	2.1	99.1
No. 30	0.600	28.3	88.4
No. 50	0.300	95.2	60.9
No. 100	0.150	187.5	23.0
No. 200	0.075	218.6	10.3

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/E35 @ 14.0

Total Sample Weight (g): 208.2
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2392

Sand : 74.2

@ 30% Passing : 0.0909

Fines : 25.8

@ 10% Passing : 0.0360

Coefficient of Uniformity: 6.64E 0

Coefficient of Curvature: 9.59E-1

Soil Classification: BROWN SILTY SAND

(SM*)

Frost Classification: --

Data Entry By: CLM

File #: 709

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/E35 @ 14.0 Data File : TEST0709

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	3.8	98.2
No. 30	0.600	29.1	86.0
No. 50	0.300	63.9	69.3
No. 100	0.150	123.2	40.8
No. 200	0.075	154.4	25.8

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/I35 @ 15.0

Total Sample Weight (g): 284.0
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2991

Sand : 85.9

@ 30% Passing : 0.1594

Fines : 14.1

@ 10% Passing : 0.0602

Coefficient of Uniformity: 4.97E 0

Coefficient of Curvature: 1.41E 0

Soil Classification: BROWN SILTY SAND

(SM*)

Frost Classification: --

Data Entry By: CLM

File #: 710

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/I35 @ 15.0Data File : TEST0710

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	8.6	97.0
No. 30	0.600	55.4	80.5
No. 50	0.300	113.2	60.1
No. 100	0.150	207.0	27.1
No. 200	0.075	243.9	14.1

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/G37 @ 16.0

Total Sample Weight (g): 323.1
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2583

Sand : 95.9

@ 30% Passing : 0.1764

Fines : 4.1

@ 10% Passing : 0.1023

Coefficient of Uniformity: 2.53E 0

Coefficient of Curvature: 1.18E 0

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 711

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/G37 @ 16.0Data File : TEST0711

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	12.9	96.0
No. 50	0.300	91.2	71.8
No. 100	0.150	267.3	17.3
No. 200	0.075	309.8	4.1

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/D-1 @ 25.0

Total Sample Weight (g): 273.0
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.3289

Sand : 87.9

@ 30% Passing : 0.1670

Fines : 12.1

@ 10% Passing : 0.0673

Coefficient of Uniformity: 4.89E 0

Coefficient of Curvature: 1.26E 0

Soil Classification: BROWN SILTY SAND

(SM*)

Frost Classification: --

Data Entry By: CLM

File #: 698

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/D-1 @ 25.0Data File : TEST0698

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	2.1	99.2
No. 30	0.600	19.6	92.8
No. 50	0.300	122.9	55.0
No. 100	0.150	203.6	25.4
No. 200	0.075	240.0	12.1

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/M-2 @ 26.0

Total Sample Weight (g): 298.2
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: --- Plasticity Index: ---

Soil Composition (%) :	Particle Diameter (mm) :
Gravel : 0.0	@ 60% Passing : 0.2612
Sand : 87.1	@ 30% Passing : 0.1560
Fines : 12.9	@ 10% Passing : 0.0654

Coefficient of Uniformity: 3.99E 0

Coefficient of Curvature: 1.42E 0

Soil Classification: BROWN SILTY SAND (SM*)

Frost Classification: --

Data Entry By: CLM

File #: 699

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/M-2 @ 26.0 Data File : TEST0699

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.3	99.9
No. 16	1.180	2.2	99.3
No. 30	0.600	9.7	96.7
No. 50	0.300	95.2	68.1
No. 100	0.150	215.6	27.7
No. 200	0.075	259.7	12.9

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 1/X-2 @ 27.0

Total Sample Weight (g): 369.7
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.3772

Sand : 98.9

@ 30% Passing : 0.2374

Fines : 1.1

@ 10% Passing : 0.1581

Coefficient of Uniformity: 2.39E 0

Coefficient of Curvature: 9.45E-1

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 700

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 1/X-2 @ 27.0 Data File : TEST0700

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	9.4	97.5
No. 50	0.300	216.2	41.5
No. 100	0.150	342.3	7.4
No. 200	0.075	365.6	1.1

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/M38 @ 17.0

Total Sample Weight (g): 294.6
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.3532

Sand : 97.1

@ 30% Passing : 0.2086

Fines : 2.9

@ 10% Passing : 0.1339

Coefficient of Uniformity: 2.64E 0

Coefficient of Curvature: 9.20E-1

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 712

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/M38 @ 17.0Data File : TEST0712

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.9	99.7
No. 30	0.600	27.1	90.8
No. 50	0.300	145.8	50.5
No. 100	0.150	261.0	11.4
No. 200	0.075	286.2	2.9

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/S38 @ 18.0

Total Sample Weight (g): 279.0
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.2789

Sand : 97.0

@ 30% Passing : 0.1861

Fines : 3.0

@ 10% Passing : 0.1164

Coefficient of Uniformity: 2.40E 0

Coefficient of Curvature: 1.07E 0

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 713

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/S38 @ 18.0Data File : TEST0713

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.1	100.0
No. 16	1.180	0.4	99.9
No. 30	0.600	6.8	97.6
No. 50	0.300	96.5	65.4
No. 100	0.150	239.9	14.0
No. 200	0.075	270.5	3.0

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/C39 @ 19.0

Total Sample Weight (g): 277.1
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: --- Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel :	0.0	@ 60% Passing :	0.2354
Sand :	95.5	@ 30% Passing :	0.1598
Fines :	4.5	@ 10% Passing :	0.0902

Coefficient of Uniformity: 2.61E 0

Coefficient of Curvature: 1.20E 0

Soil Classification: BROWN SAND (SP)

Frost Classification: --

Data Entry By: CLM

File #: 714

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/C39 @ 19.0Data File : TEST0714

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	3.7	98.7
No. 50	0.300	58.8	78.8
No. 100	0.150	207.6	25.1
No. 200	0.075	264.5	4.5

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/M-4 @ 20.0

Total Sample Weight (g): 325.4
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.3193

Sand : 98.1

@ 30% Passing : 0.2017

Fines : 1.9

@ 10% Passing : 0.1475

Coefficient of Uniformity: 2.16E 0

Coefficient of Curvature: 8.64E-1

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 715

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/M-4 @ 20.0Data File : TEST0715

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	16.3	95.0
No. 50	0.300	141.4	56.5
No. 100	0.150	292.2	10.2
No. 200	0.075	319.2	1.9

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: AREA 2/G43 @ 21.0

Total Sample Weight (g): 332.6 ~
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.3337

Sand : 98.3

@ 30% Passing : 0.2047

Fines : 1.7

@ 10% Passing : 0.1456

Coefficient of Uniformity: 2.29E 0

Coefficient of Curvature: 8.63E-1

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 716

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : AREA 2/G43 @ 21.0Data File : TEST0716

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.3	99.9
No. 30	0.600	25.1	92.5
No. 50	0.300	152.6	54.1
No. 100	0.150	298.1	10.4
No. 200	0.075	327.1	1.7

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: C AREA/A31 @ 23.0

Total Sample Weight (g): 297.1
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: --- Plasticity Index: ---

Soil Composition (%) :	Particle Diameter (mm) :
Gravel : 0.0	@ 60% Passing : 0.5073
Sand : 99.3	@ 30% Passing : 0.3311
Fines : 0.7	@ 10% Passing : 0.1899

Coefficient of Uniformity: 2.67E 0

Coefficient of Curvature: 1.14E 0

Soil Classification: BROWN SAND (SP)

Frost Classification: --

Data Entry By: CLM

File #: 717

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : C AREA/A31 @ 23.0Data File : TEST0717

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.7	99.8
No. 30	0.600	83.8	71.8
No. 50	0.300	228.6	23.1
No. 100	0.150	287.4	3.3
No. 200	0.075	295.0	0.7

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: C AREA/S31 @ 22.0

Total Sample Weight (g): 319.9
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: ---

Plasticity Index: ---

Soil Composition (%):

Particle Diameter (mm):

Gravel : 0.0

@ 60% Passing : 0.3208

Sand : 99.2

@ 30% Passing : 0.2089

Fines : 0.8

@ 10% Passing : 0.1579

Coefficient of Uniformity: 2.03E 0

Coefficient of Curvature: 8.62E-1

Soil Classification: BROWN SAND

(SP)

Frost Classification: --

Data Entry By: CLM

File #: 718

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993

Data Entry By : CLM Location : C AREA/S31 @ 22.0 Data File : TEST0718

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.0	100.0
No. 16	1.180	0.0	100.0
No. 30	0.600	3.6	98.9
No. 50	0.300	141.3	55.8
No. 100	0.150	299.6	6.3
No. 200	0.075	317.4	0.8

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project Name: HLA-FORT ORD SITE3
Project Number: HLA.2-4405

Test Date: 12-15-1993
Location: C AREA @ 24.0

Total Sample Weight (g): 342.2
Percent Passing No. 10 Sieve : 0.0
Representative Sample Weight (g): ----

PI Results (used in determining fines classification)

Liquid Limit: --- Plasticity Index: ---

Soil Composition (%)	Particle Diameter (mm)
Gravel : 0.0	@ 60% Passing : 0.7753
Sand : 86.6	@ 30% Passing : 0.4391
Fines : 13.4	@ 10% Passing : 0.0000

Coefficient of Uniformity: 4.31E12

Coefficient of Curvature: 1.38E12

Soil Classification: BROWN SILTY SAND (SM*)

Frost Classification: --

Data Entry By: CLM

File #: 719

Particle Size Analysis
Sieve Method
HLA Laboratory Analysis Routines Ver 3.0

Project : HLA-FORT ORD SITE3 ID : HLA.2-4405 Test Date : 12-15-1993
Data Entry By : CLM Location : C AREA @ 24.0 Data File : TEST0719

Sieve Name	Sieve Size (mm)	Cum. Weight Retained (g)	Percent of Total Weight Passing
5.000 in	125.000	0.0	100.0
3.000 in	75.000	0.0	100.0
1.500 in	37.500	0.0	100.0
3/4 in	19.000	0.0	100.0
3/8 in	9.500	0.0	100.0
No. 4	4.750	0.0	100.0
No. 8	2.360	0.0	100.0
No. 10	2.000	0.3	99.9
No. 16	1.180	38.0	88.9
No. 30	0.600	197.2	42.4
No. 50	0.300	291.2	14.9
No. 100	0.150	296.1	13.5
No. 200	0.075	296.4	13.4

SOLEA

LABORATORY TESTING PROGRAM

LSN

SOLEA TESTING GROUP

Sample Receipt Record

T NAME <i>Yandling Lawson</i>		CONTRACT NO.	SOLEA CLIENT NUMBER
CLIENT PROJECT <i>Fort Ord Site 3</i>		REPORT ADDRESS <i>716551 Redwood Blvd. PO Box 572</i>	DATE VERBAL RESULTS DUE
<i>23366.02521</i>		CITY <i>Novato Ca. 94948</i>	DATE FINAL REPORT DUE
CLIENT PROJECT NO <i>Chris Rossitto</i>		INVOICE ADDRESS <i>same as above</i>	RECEIVED BY / DATE <i>12/10/93 JCL</i>
CONTACT / REPORT TO <i>Chris Rossitto</i>		CITY	HAZARD I.D.
TESTS ASSIGNED BY <i>Frank Ortwies</i>		PHONE NUMBER <i>(415) 884-3188</i>	SEE LABORATORY HEALTH AND SAFETY PLAN
SAMPLES RELINQUISHED BY		FAX NUMBER	SAMPLE TYPE CODE ST-shelby, BT-brass, SS-stainless, BK-bulk, EG-baggie, J-jar

HOLE NO	SAMPLE I.D.	DEPTH (FT)	SAMPLE TYPE	SAMPLE CONDITION	CONTAMINATED	SAMPLE RECEIVED	MOISTURE CONTENT	MOISTURE AND DENSITY	SPECIFIC GRAVITY	ATTERBERG LIMIT, 3-PT	SIEVE ANALYSIS TO #200	PERCENT PASSING #200	HYDROMETER ANALYSIS	COMPACTION (MODIFIED)	R-VALUE	CONSOLIDATION	TRIAXIAL PERMEABILITY*	AIR PERMEABILITY	UNCONFINED COMPRESSION	DIRECT SHEAR (UU)*	TRIAXIAL SHEAR (UU)*	TRIAXIAL SHEAR (CU)*	*CONFINING PRESSURE (PSI)	REMARKS
SPECIAL INSTRUCTIONS																								
✓ 1	Area 1	25																						
✓ 1	D-1																							
✓ 2	Area 1	26																						
✓ 2	M-2																							
✓ 2	Area 1	27																						
✓ 2	X-2																							
✓ 4	Area 1	28																						
✓ 4	U-6																							
✓ 5	Area 1	FD																						
✓ 5	K-4	2-629																						
✓ 6	Area 1	30																						
✓ 6	O-9																							
✓ 7	Area 1	31																						
✓ 7	T-9																							
✓ 8	Area 1	32																						
✓ 8	K-13																							
✓ 9	Area 1	33																						
✓ 9	E-15																							
✓ 10	Area 1	34																						
✓ 10	L-14																							
✓ 11	Area 2	13																						
✓ 11	S-19																							
✓ 12	Area 2	14																						
✓ 12	E-35																							
✓ 13	Area 2	15																						
✓ 13	T-35																							
✓ 14	Area 2	16																						
✓ 14	G-37																							
✓ 15	Area 2	17																						
✓ 15	M-38																							
TALLY																								

SPECIAL INSTRUCTIONS

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STORAGE LOCATION

LEGEND

NOTES

TEST ASSIGNED

TEST PREPARED

TEST COMPLETED

TEST COMPUTERIZED

SOLEA

SOLEA TESTING GROUP

LABORATORY TESTING PROGRAM

Sample Receipt Record

CLIENT NAME <i>Harding Lawson</i>	CONTRACT NO.	SOLEA CLIENT NUMBER
CLIENT PROJECT <i>Fort Ord Site 3</i>	REPORT ADDRESS <i>76551 Redwood Blvd. Box 578</i>	DATE VERBAL RESULTS DUE
CLIENT PROJECT NO. <i>233660.02521</i>	CITY <i>Novato Ca. 94948</i>	DATE FINAL REPORT DUE
CONTACT / REPORT TO <i>Chris Rossitto</i>	INVOICE ADDRESS <i>Same as above</i>	RECEIVED BY / DATE <i>W. O. 10/10/00</i>
TESTS ASSIGNED BY <i>Frank Drewes</i>	PHONE NUMBER <i>(415) 884-3188</i>	HAZARD I.D.
SAMPLES RELINQUISHED BY	FAX NUMBER	SEE LABORATORY HEALTH AND SAFETY PLAN
		SAMPLE TYPE CODE ST=shelby, BT=brass, SS=stainless BK=bulk, EG=egg, J=jar

HOLE NO.	SAMPLE I.D.	DEPTH (FT)	SAMPLE TYPE	SAMPLE CONDITION	CONTAMINATED	SAMPLE RECEIVED	MOISTURE CONTENT	MOISTURE AND DENSITY	SPECIFIC GRAVITY	ATTERBERG LIMIT, 3-PT	SIEVE ANALYSIS TO #200	PERCENT PASSING #200	HYDROMETER ANALYSIS	COMPACTION (MODIFIED)	R-VALUE	CONSOLIDATION	TRIAxIAL PERMEABILITY*	AIR PERMEABILITY	UNCONFINED COMPRESSION	DIRECT SHEAR (UU)*	TRIAxIAL SHEAR (UU)*	TRIAxIAL SHEAR (CU)*	*CONFINING PRESSURE (PSI)	RE MARKS
SPECIAL INSTRUCTIONS																								
✓ 1	Area 2 5-38	18																						
✓ 2	Area 2 4-39	19																						
✓ 3	Area 2 11-41	20																						
✓ 4	Area 2 6-43	21																						
✓ 5	Control 0-31	22																						
✓ 6	Control 5-31	22																						
✓ 7	Beach	24																						
8																								
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10																								
11																								
12																								
13																								
14																								
15																								
TALLY																								

SPECIAL INSTRUCTIONS

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STORAGE LOCATION

LEGEND

NOTES

TEST ASSIGNED

TEST PREPARED

TEST COMPLETED

TEST COMPUTERIZED

APPENDIX D
DATA VALIDATION REPORT

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TABLE

D-1 Samples Collected from Site 3

DATA VALIDATION REPORT

Analytical results for Site 3, consisting of eight sample delivery groups (SDGs 072675, 072949, 072976, 073014, 073031, 073115, 073677, and 074061) were validated according to procedures specified in the Fort Ord QAPP (*Part 2 of HLA, 1991b*), QAPP Revisions (*HLA, 1992k*), and Part 2 of the Draft Site Characterization Report, Site 34, Fritzsche Army Airfield Fueling Facility (*HLA, 1992*). The quality of the data was evaluated with respect to a set of quality control (QC) criteria, including precision, accuracy, and completeness. The QC samples used to assess data quality consisted of laboratory duplicate samples, matrix spike/matrix spike duplicates (MS/MSD), blank spike/blank spike duplicates (BS/BSD; also known as laboratory control samples [LCS]), method blanks, source water blanks, trip blanks, equipment rinsate blanks, and field duplicate samples. Holding times and laboratory surrogate spike recoveries were also evaluated. In addition, SDG 072976 underwent a detailed validation in which calibrations, internal standards, GC/MS tuning records, furnace AA duplicate injection precision, furnace AA post-digestion spikes, and compound quantifications were evaluated. Results of the data validation are presented below.

D1.0 ANALYTICAL SUMMARY

During the 1993 sampling at Site 3, 69 soil samples, 15 soil samples (each split into 4 samples for leachate analysis [60 total leachate samples]), one rainwater sample, and 32 air filter samples, including associated field QC samples, were collected and submitted to Enseco for analysis. Table D-1 lists identifiers for the samples collected from Site 3 between October 19 and December 9, 1993, and analyzed by Enseco between October 19, 1993, and January 20, 1994.

Analytical methods used for the samples included one or more of the following test methods. Not all samples were analyzed for the same set of parameters.

Organics: EPA Test Method 415.1 - Total Organic Carbon

Inorganics: EPA Test Method 6010/7000 - Metals
EPA Test Method 7196 - Hexavalent Chromium (CrVI)
EPA Test Method 9045 - Soil pH
EPA Test Method 9081 - Cation Exchange Capacity
Test Method PM10 - Total Suspended Particulates

D2.0 ORGANIC ANALYSES

This section summarizes the findings of the evaluation of the QC samples, including the detailed validation of SDG 072976.

D2.1 EPA Test Method 415.1 - Total Organic Carbon

- Holding Times: Holding time criteria were met for all samples.
- Blanks: No analytes were detected in the laboratory method blank. No field-generated blanks were collected.
- BS/BSD: All recoveries and RPD values were within control limits.

- MS/MSD: Samples 9348Q003001F, 9348T003032F, 9348T003057F, and 9349S003007F were spiked. All recoveries and RPD values were within control limits.
- Field Duplicates: No field duplicates were collected.
- Calibration: The instrument calibration was reviewed for SDG 072976 only. All initial and continuing calibrations were acceptable.

D3.0 INORGANIC ANALYSES

This section summarizes the findings of the evaluation of the QC samples, including the detailed validation of SGD 072976.

D3.1 EPA Test Method 6010/7000 - Metals

- Holding Times: Holding time criteria were met for all samples.
- Blanks: Chromium, copper, iron, and zinc were detected in laboratory calibration and method blanks associated with the six soil SDGs. All were present below the reporting limit. Detected results for the above metals were qualified as nondetected (U1) if they were reported at concentrations less than or equal to five times the highest concentration observed in any laboratory blank associated with the same SDG. Data for the following metals and samples were affected:
 - Zinc in Samples 9348T003051F, 9348T003052F, 9348Q003018F, 9348T003056FSR, 9348T003054FSR, 9348T003062FSR, 9348T003060FSR, 9348T003020FSR, 9348T003006FSR, 9348T003004FSR, 9348T003044FSS, 9348T003054FSS, 9348T003064FSS, 9348T003060FSS, 9348T003006FSS, 9348T003044FUR, 9348T003056FUR, 9348T003058FUR, 9348T003054FUR, 9348T003020FUR, 9348T003075FUR, 9348T003006FUR, 9348T003004FUR, 9348T003042FUS, 9348T003046FUS, 9348T003044FUS, 9348T003056FUS, 9348T003064FUS, 9348T003062FUS, 9348T003020FUS, 9348T003004FUS, and 9348T003008FUS.

Sample data for the other metals were not affected, because the results were either nondetected or above five times the highest blank concentration.

Antimony, copper, and zinc were detected at concentrations below the reporting limit in laboratory calibration blanks, method blanks, and laboratory filter blanks associated with the air filter SDG. Data for these metals were not affected because the field sample results were either nondetected or above five times the highest blank value.

Copper and zinc were detected in the field blank associated with the air filter SDG. Detected results for the above metals were qualified as nondetected (U2) if the weight detected on the filter was less than or equal to 5 times the weight detected in the field blank. The following sample results were affected:

- Zinc in Samples 9342P003003F, 9343P003001F, 9343P003007F, 9343P003008F, 9344R003001F, 9344R003004F, 9344P003011F, 9344P003015F, 9344P003019F, and 9345P003022F.

Sample data for copper were not affected because the weight detected on each filter was greater than five times the weight detected in the field blank.

- BS: The recoveries for the blank spikes were high for the following: antimony in SDGs 073031, 073014, and 072949; iron in SDG 073031; lead in SDGs 073014 and 074061; tin in SDG 073677; and zinc in SDG 073677. SDG 074061 consisted of air filter samples; because no limits exist for filter samples, this SDG was evaluated using soil QC limits. The following detected results are qualified as estimated (J3) due to noncompliance with blank spike criteria:
 - Antimony in Samples 9348Q003002F, 9348Q003003F, 9348Q003009F, 9348Q003011F, 9348Q003013F, 9348T003019F, 9348T003023F, 9348T003029F, 9348T003057F, 9348T003059F, 9348T003061F, 9348T003063F, 9348T003065F, 9348T003066F, 9348T003067F, 9348T003068F, 9348T003069F, 9348T003070F, 9348T003071F, 9348T003072F, 9348T003073F, 9348T003074F, 9349S003001F, 9349S003002F, 9349S003003F, 9349S003004F, 9349S003005F, 9349S003006F, 9349S003007F, 9349S003008F, 9349S003009F, 9349S003010F, 9349S003011F, 9349S003012F, 9349Y003035F, 9349Y003036F, and 9349Y003037F.
 - Iron in Samples 9349S003007F, 9349S003008F, 9349S003009F, 9349S003010F, 9349S003011F, 9349S003012F, 9349Y003035F, 9349Y003036F, and 9349Y003037F.
 - Lead in Samples 9348T003059F, 9342P003003F, 9343P003001F, 9343P003007F, 9343P003008F, 9344R003001F, 9344R003004F, 9344P003011F, 9344P003015F, 9344P003019F, 9345P003022F, and 9345P003023C.

Because all affected tin and zinc results were nondetected, no qualification is necessary.

The recoveries for the blank spike was low for the following: iron in SDG 072949. The following detected and nondetected results are qualified as estimated (J3) due to noncompliance with matrix spike criteria:

- Iron in Samples 9348Q003005F, 9348Q003011F, and 9348T003025F.
- MS: Samples 9342P003003F, 9348Q003001F, 9348T003057F, 9349S003007F, 9348T003042FUR, 9348T003032F, and 9348T003042FSR were spiked. The recoveries for the following spiked Samples were high: antimony in spiked Sample 9348T003057F; copper in spiked Samples 9342P003003F and 9348T003032F; iron in spiked Sample 9348T003042FUR; lead in spiked Sample 9342P003003F; and tin in spiked Sample 9348T003057F. The following detected results are qualified as estimated (J3) due to noncompliance with matrix spike criteria:
 - Antimony in Samples 9348T003057F, 9348T003059F, 9348T003061F, 9348T003063F, 9348T003065F, 9348T003066F, 9348T003067F, 9348T003068F, 9348T003069F, 9348T003070F, 9348T003071F, 9348T003072F, 9348T003073F, 9348T003074F, 9349S003001F, 9349S003002F, 9349S003003F, 9349S003004F, 9349S003005F, and 9349S003006F.
 - Copper in Samples 9342P003003F, 9343P003001F, 9343P003007F, 9343P003008F, 9344R003001F, 9344R003004F, 9344P003011F, 9344P003015F, 9344P003019F, 9345P003022F, 9345P003023C, 9348T003032F, 9348T003033F, 9348T003034F, 9348T003035F, 9348T003037F, 9348T003038F, 9348T003039F, 9348T003040F, 9348T003041F, 9348T003043F, 9348T003045F, 9348T003047F, 9348T003048F, 9348T003049F, 9348T003050F, 9348T003051F, 9348T003052F, and 9348T003053F.
 - Iron in Samples 9348T003042FUR, 9348T003046FUR, 9348T003044FUR, 9348T003056FUR, 9348T003058FUR, 9348T003054FUR, 9348T003064FUR, 9348T003062FUR,

9348T003060FUR, 9348T003020FUR, 9348T003022FUR, 9348T003075FUR, 9348T003006FUR, 9348T003004FUR, 9348T003008FUR, 9348T003042FUS, 9348T003046FUS, 9348T003044FUS, 9348T003056FUS, 9348T003058FUS, 9348T003054FUS, 9348T003064FUS, 9348T003062FUS, 9348T003060FUS, 9348T003020FUS, 9348T003022FUS, 9348T003075FUS, 9348T003006FUS, 9348T003004FUS, and 9348T003008FUS.

- Lead in Samples 9342P003003F, 9343P003001F, 9343P003007F, 9343P003008F, 9344R003001F, 9344R003004F, 9344P003011F, 9344P003015F, 9344P003019F, 9345P003022F, and 9345P003023C.
- Tin in Samples 9348T003057F, 9348T003059F, 9348T003061F, 9348T003063F, 9348T003065F, 9348T003066F, 9348T003067F, 9348T003068F, 9348T003069F, 9348T003070F, 9348T003071F, 9348T003072F, 9348T003073F, 9348T003074F, 9349S003001F, 9349S003002F, 9349S003003F, 9349S003004F, 9349S003005F, and 9349S003006F.

The recoveries for the following spiked samples were low but above 30 percent: antimony in spiked Sample 9342P003003F; and zinc in spiked Sample 9348T003057F. The following detected and nondetected results are qualified as estimated (J3) due to noncompliance with matrix spike criteria:

- Antimony in Samples 9342P003003F, 9343P003001F, 9343P003007F, 9343P003008F, 9344R003001F, 9344R003004F, 9344P003011F, 9344P003015F, 9344P003019F, 9345P003022F, and 9345P003023C.
- Zinc in Samples 9348T003057F, 9348T003059F, 9348T003061F, 9348T003063F, 9348T003065F, 9348T003066F, 9348T003067F, 9348T003068F, 9348T003069F, 9348T003070F, 9348T003071F, 9348T003072F, 9348T003073F, 9348T003074F, 9349S003001F, 9349S003002F, 9349S003003F, 9349S003004F, 9349S003005F, and 9349S003006F.

The recoveries for the following spiked samples were low and below 30 percent: antimony and chromium in spiked Sample 9348Q003001F. The following detected results are qualified as estimated (J3) and the nondetected results are qualified as rejected (R2) due to noncompliance with matrix spike criteria:

- Antimony and chromium in Samples 9348Q003001F, 9348Q003002F, 9348Q003003F, 9348Q003005F, 9348Q003007F, 9348Q003009F, 9348Q003011F, 9348Q003013F, 9348Q003015F, 9348Q003016F, 9348Q003017F, 9348Q003018F, 9348T003019F, 9348T003021F, 9348T003023F, 9348T003025F, 9348T003027F, 9348T003029F, 9348T003030F, and 9348T003031F.
- Samples 9348T003042FUR and 9348T003042FSR were spiked in duplicate. All RPD values were within control limits.
- Laboratory Duplicates: Samples 9342P003003F, 9348Q003001F, 9348T003057F, 9349S003007F, and 9348T003032F were analyzed in duplicate. The RPD values or the absolute differences for the following duplicate samples were not within control limits: antimony in Samples 9348T003057F and 9348Q003001F; chromium in Sample 9349S003007F; iron in Sample 9349S003007F; lead in Sample 9348Q003001F; and tin in Samples 9348T003057F and 9348Q003001F. The following detected results are qualified as estimated (J2) due to noncompliance with duplicate precision criteria:

- Antimony in Samples 9348Q003001F, 9348Q003002F, 9348Q003003F, 9348Q003005F, 9348Q003007F, 9348Q003009F, 9348Q003011F, 9348Q003013F, 9348Q003015F, 9348Q003016F, 9348Q003017F, 9348Q003018F, 9348T003019F, 9348T003021F, 9348T003023F, 9348T003025F, 9348T003027F, 9348T003029F, 9348T003030F, 9348T003031F, 9348T003057F, 9348T003059F, 9348T003061F, 9348T003063F, 9348T003065F, 9348T003066F, 9348T003067F, 9348T003068F, 9348T003069F, 9348T003070F, 9348T003071F, 9348T003072F, 9348T003073F, 9348T003074F, 9349S003001F, 9349S003002F, 9349S003003F, 9349S003004F, 9349S003005F, and 9349S003006F.
- Chromium in Samples 9349S003007F, 9349S003008F, 9349S003009F, 9349S003010F, 9349S003011F, 9349S003012F, 9349Y003035F, 9349Y003036F, and 9349Y003037F.
- Iron in Samples 9349S003007F, 9349S003008F, 9349S003009F, 9349S003010F, 9349S003011F, 9349S003012F, 9349Y003035F, 9349Y003036F, and 9349Y003037F.
- Lead in Samples 9348Q003001F, 9348Q003002F, 9348Q003003F, 9348Q003005F, 9348Q003007F, 9348Q003009F, 9348Q003011F, 9348Q003013F, 9348Q003015F, 9348Q003016F, 9348Q003017F, 9348Q003018F, 9348T003019F, 9348T003021F, 9348T003023F, 9348T003025F, 9348T003027F, 9348T003029F, 9348T003030F, and 9348T003031F.
- Tin in Samples 9348Q003001F, 9348Q003002F, 9348Q003003F, 9348Q003005F, 9348Q003007F, 9348Q003009F, 9348Q003011F, 9348Q003013F, 9348Q003015F, 9348Q003016F, 9348Q003017F, 9348Q003018F, 9348T003019F, 9348T003021F, 9348T003023F, 9348T003025F, 9348T003027F, 9348T003029F, 9348T003030F, 9348T003031F, 9348T003057F, 9348T003059F, 9348T003061F, 9348T003063F, 9348T003065F, 9348T003066F, 9348T003067F, 9348T003068F, 9348T003069F, 9348T003070F, 9348T003071F, 9348T003072F, 9348T003073F, 9348T003074F, 9349S003001F, 9349S003002F, 9349S003003F, 9349S003004F, 9349S003005F, and 9349S003006F.
- Calibration: The instrument calibration was reviewed for SDG 072976 only. All initial and continuing calibrations were acceptable.
- ICP Interference Check Sample (ICS): The ICS was reviewed for SDG 072976 only. All recoveries were within control limits.
- ICP Serial Dilution analysis: Serial dilutions were reviewed for SDG 072976 only. The serial dilution %D for zinc was not within the control limits. The following detected results are qualified as estimated (J4) due to noncompliance with serial dilution criteria:
 - Zinc in Samples 9348T003032F, 9348T003033F, 9348T003034F, 9348T003035F, 9348T003036F, 9348T003037F, 9348T003038F, 9348T003039F, 9348T003040F, 9348T003041F, 9348T003043F, 9348T003045F, 9348T003047F, 9348T003048F, 9348T003049F, 9348T003050F, 9348T003051F, 9348T003052F, 9348T003053F, and 9348T003055F.
- GFAA Post-Digestion Spikes: Post-digestion spikes were reviewed for SDG 072976 only. The recoveries for tin in some samples were not within the control limits. The following detected and nondetected results are qualified as estimated (J3) due to noncompliance with spike recovery criteria:

- Tin in Samples 9348T003033F, 9348T003037F, 9348T003041F, 9348T003045F, 9348T003048F, 9348T003049F, 9348T003050F, and 9348T003051F.
- Compound Quantification: This was reviewed for SDG 072976 only. No errors in quantification were encountered.

D3.2 EPA Test Method 7196 - Hexavalent Chromium

- Holding Times: Holding time criteria were met for all samples.
- Blanks: No analytes were detected in the laboratory method blank. No field-generated blanks were collected.
- BS/BSD: All recoveries and RPD values were within control limits.
- MS: The recoveries for hexavalent chromium (CrVI) matrix spikes associated with SDGs 072949, 073014, and 073031 were below 30 percent. The recovery for the CrVI matrix spike associated with SDG 072976 was low but above 30 percent. Matrix spike samples were reanalyzed and similar recoveries were obtained. BS/BSD data were acceptable, which indicates that the method was in control. However, MS data indicate that the method, as applied to the site-specific sample matrix, produces unreliable results. CrVI analysis is unique with respect to the stability of the analyte in the matrix; under most field and laboratory analytical conditions, CrVI in soil will be reduced to trivalent chromium (CrIII) so rapidly that it is difficult to obtain acceptable CrVI matrix spike recoveries. Data validation guidelines or data qualification protocol do not provide for an appropriate mechanism to address data quality under these unique circumstances. Therefore, the N2 (Not Qualified) code has been applied to the CrVI results. Data usability for CrVI results is addressed in further detail in Section 4.4 of the Introduction to Volume II of the RI/FS report.
- Laboratory Duplicates: Samples 9348Q003001F, 9348T003032F, 9348T003057F, and 9349S003007F were analyzed in duplicate. All results were nondetected.
- Calibration: The instrument calibration was reviewed for SDG 072976 only. All initial and continuing calibrations were acceptable.

D3.3 EPA Test Method 9045 - Soil pH

- Holding Times: All samples except 9345P003023F were analyzed for pH beyond the 24-hour holding time. All detected results in these samples are qualified as estimated (J5) due to noncompliance with holding time criteria.
- Laboratory Duplicates: Samples 9348Q003001F, 9348T003032F, 9348T003057F, and 9349S003007F were analyzed in duplicate. All values were within control limits.

D3.4 EPA Test Method 9081 - Cation Exchange Capacity

- Holding Times: Holding time criteria were met for all samples.
- Blanks: No analytes were detected in the laboratory method blanks. No field-generated blanks were collected.
- BS/BSD: All recoveries and RPD values were within control limits.

- Calibration: The instrument calibration was reviewed for SDG 072976 only. All calibrations were acceptable.

D3.5 EPA Test Method PM-10 - Total Suspended Particulates

No QA/QC information was provided for this analysis. One field blank (9345P003023C) was analyzed, with no total suspended particulates detected.

D4.0 QA/QC SUMMARY

D4.1 Laboratory QC Summary

No QC issues were raised in any Site 3 case narrative that were not previously discussed in this appendix.

D4.2 Completeness

Completeness is defined as the ratio of the number of acceptable data points to the total number of data points reported. The following criteria were used to identify whether a data point is acceptable in the completeness calculation. Hexavalent chromium was not included in the completeness calculation because of sample matrix considerations and its unique QC circumstances.

- All data points in a sample for which the holding time criterion was not met will not be counted as acceptable in the completeness calculation
- All data points that received an R-qualifier in the data validation will not be counted as acceptable in the completeness calculation.

For Site 3, completeness of the data for the requested test methods are as follows:

EPA Test Method 415.1 - Total Organic Carbon	100%
EPA Test Method 6010/7000 - metals	99%
EPA Test Method 7196 - Hexavalent Chromium	NA
EPA Test Method 9045 - Soil pH	1%
EPA Test Method 9081 - Cation Exchange Capacity	100%

D4.3 Data Quality Summary

Results of the data validation indicate that the data are useable when the data quality objectives of the project are considered. Data quality objectives are presented in Section 4.4 of this report. The completeness goal of 80 percent was met for all test methods except pH.

Only one sample for pH was analyzed within analytical holding time. All other samples were analyzed for pH after the holding time had expired.

- Results of 168 sample analyses for antimony, copper, iron, lead, and tin were qualified as estimated due to high recoveries for blank spikes or matrix spikes. A high spike recovery can result from either a sample matrix effect or a measurement bias in the analytical system. This could result in the overestimation of the amount of these metals in the associated samples, which would add to the conservativeness of the contamination assessment.

- Thirty-four analytical results for antimony, iron, and zinc were qualified as estimated due to low blank spike or matrix spike recoveries. All of the spike recoveries were above 45 percent. This could result in an underestimation of actual concentrations; including reporting of false negatives. However, for these metals, the laboratory instrument detection limits are at least one-third of the reporting limit for these metals. Therefore, because the laboratory can detect these metals well below their respective reporting limits, it is unlikely that false negatives were reported. In addition, these metals are generally co-located with lead, which is the primary chemical of concern.
- In 118 sample analyses, results for antimony, chromium, iron, lead, and tin were qualified as estimated because laboratory duplicate precision criteria were not met. Duplicate precision criteria are a measure of the stability of the analytical system. They do not indicate that instrument sensitivity is affected, and the potential for false negatives or false positives is very low.
- Twenty sample analytical results for zinc were qualified as estimated because the serial dilution criterion for inductively coupled plasma (ICP) was not met. Serial dilution outside control limits indicates a sample matrix effect that varies as the sample is diluted. This does not indicate that instrument sensitivity is affected, and the potential for false negatives or false positives is very low because samples containing low concentrations would not be significantly diluted.
- Twenty sample analytical results for antimony and chromium were qualified due to matrix spike recoveries below 30 percent. Of these, nine results for antimony were "Not Detected" (ND) and qualified as rejected. The remaining sample results were detected and were qualified as estimated. When the spike recovery is below 30 percent, the potential for reporting false negatives is significant. Antimony and chromium are generally collocated with lead, which is the primary contaminant.
- Four SDGs had CrVI matrix spike recoveries below the control limits; three of the spike recoveries were below 30 percent. Matrix spike samples were reanalyzed and similar recoveries were obtained. BS/BSD data indicate that the method was in control. MS data indicates that the method, as applied to the site-specific sample matrix, produces unreliable results. CrVI analysis is unique with respect to the stability of the analyte in the matrix; under most field and laboratory analytical conditions, CrVI in soil will be rapidly reduced to trivalent chromium (CrIII), rendering CrVI matrix spike data inconclusive. Data validation guidelines or data qualification protocol do not provide for an appropriate mechanism to address data quality under these unique circumstances. Therefore the N2 (Not Qualified) code has been applied to the CrVI results. HLA believes that the CrVI data are usable even when associated with poor QC results, because matrix spike data indicate that soil conditions at the site do not favor the formation or stability of CrVI. Further discussion of CrVI results can be found in Section 4.4 of the Introduction to Volume II of the RI/FS report.

D4.4 Corrective Action

The following corrective actions have been recommended to Enseco regarding future analytical work:

- Provide more detail in the case narratives about any anomaly encountered in the course of the sample analysis. Include descriptive notations made by the bench chemists regarding the interpretation and deconvolution of QC information. Such details can be of great value to reviewers in the data validation efforts. Consequently, the data can be correctly qualified.

- Find a different source of soil blank spikes for metals. A different source should minimize much of the metals data resulting from blank spike exceedances
- Reextract and reanalyze affected samples at least once in the event that blank spike or matrix spike control limits are exceeded. This will result in an improved mechanism for assessing if QC exceedances are due to laboratory error or matrix effects. Make every effort to perform reextractions and reanalyses within specified holding times.

Table D-1. Samples Collected from Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Lab Number	Station Number	Sample Type	Sample Number
072675-0001	Firing Range 12	Rainwater	9345P003023F
072949-0001	Area1-X-2 at 0.13'	Soil	9348Q003001F
072949-0002	Area1-X-2 at 0.75'	Soil	9348Q003002F
072949-0003	Area1-X-2 at 2.75'	Soil	9348Q003003F
072949-0004	Area1-U-6 at 0.13'	Soil	9348Q003005F
072949-0005	Area1-U-6 at 0.92'	Soil	9348Q003007F
072949-0006	Area1-U-6 at 2.75'	Soil	9348Q003009F
072949-0007	Area1-O-9 at 0.13'	Soil	9348Q003011F
072949-0008	Area1-O-9 at 1.0'	Soil	9348Q003013F
072949-0009	Area1-O-9 at 2.75'	Soil	9348Q003015F
072949-0010	Area1-K-13 at 0.13'	Soil	9348Q003016F
072949-0011	Area1-K-13 at 1.0'	Soil	9348Q003017F
072949-0012	Area1-K-13 at 2.75'	Soil	9348Q003018F
072949-0013	Area1-M-2 at 0.13'	Soil	9348T003019F
072949-0014	Area1-M-2 at 2.25'	Soil	9348T003021F
072949-0015	Area1-M-2 at 6.25'	Soil	9348T003023F
072949-0016	Area1-D-1 at 0.13'	Soil	9348T003025F
072949-0017	Area1-D-1 at 0.33'	Soil	9348T003027F
072949-0018	Area1-D-1 at 2.25'	Soil	9348T003029F
072949-0019	Area1-K-4 at 0.13'	Soil	9348T003030F
072949-0020	Area1-K-4 at 0.96'	Soil	9348T003031F
072976-0001	Area1-K-4 at 2.25'	Soil	9348T003032F
072976-0002	Area1-I-9 at 0.13'	Soil	9348T003033F
072976-0003	Area1-I-9 at 0.75'	Soil	9348T003034F
072976-0004	Area1-I-9 at 2.25'	Soil	9348T003035F
072976-0005	Area1-E-15 at 0.13'	Soil	9348T003036F
072976-0006	Area1-E-15 at 0.75'	Soil	9348T003037F
072976-0007	Area1-E-15 at 2.25'	Soil	9348T003038F
072976-0008	Area1-C-14 at 0.13'	Soil	9348T003039F
072976-0009	Area1-C-14 at 0.75'	Soil	9348T003040F
072976-0010	Area1-C-14 at 2.25'	Soil	9348T003041F
072976-0011	Control-S-31 at 0.13'	Soil	9348T003043F
072976-0012	Control-S-31 at 0.88'	Soil	9348T003045F
072976-0013	Control-S-31 at 2.25'	Soil	9348T003047F
072976-0014	Control-A-31 at 0.13'	Soil	9348T003048F
072976-0015	Control-A-31 at 0.88'	Soil	9348T003049F

**Table D-1. Samples Collected from Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California**

Lab Number	Station Number	Sample Type	Sample Number
072976-0016	Control-A-31 at 2.0'	Soil	9348T003050F
072976-0017	Control-Beach at 0.13'	Soil	9348T003051F
072976-0018	Control-Beach at 0.88'	Soil	9348T003052F
072976-0019	Control-Beach at 2.0'	Soil	9348T003053F
072976-0020	Area2-E-35 at 0.13'	Soil	9348T003055F
073014-0001	Area2-E-35 at 0.33'	Soil	9348T003057F
073014-0002	Area2-E-35 at 1.75'	Soil	9348T003059F
073014-0003	Area2-I-35 at 0.08'	Soil	9348T003061F
073014-0004	Area2-I-35 at 0.29	Soil	9348T003063F
073014-0005	Area2-I-35 at 1.75'	Soil	9348T003065F
073014-0006	Area2-G-37 at 0.13'	Soil	9348T003066F
073014-0007	Area2-G-37 at 0.33'	Soil	9348T003067F
073014-0008	Area2-G-37 at 1.75'	Soil	9348T003068F
073014-0009	Area2-L-39 at 0.13'	Soil	9348T003069F
073014-0010	Area2-L-39 at 0.38'	Soil	9348T003070F
073014-0011	Area2-L-39 at 1.75'	Soil	9348T003071F
073014-0012	Area2-G-43 at 0.13'	Soil	9348T003072F
073014-0013	Area2-G-43 at 0.75'	Soil	9348T003073F
073014-0014	Area2-G-43 at 1.75	Soil	9348T003074F
073014-0015	Area2-S-38 at 0.13	Soil	9349S003001F
073014-0016	Area2-S-38 at 0.88'	Soil	9349S003002F
073014-0017	Area2-S-38 at 2.25'	Soil	9349S003003F
073014-0018	Area2-P-39 at 0.13'	Soil	9349S003004F
073014-0019	Area2-P-39 at 0.63'	Soil	9349S003005F
073014-0020	Area2-P-39 at 2.0'	Soil	9349S003006F
073031-0001	Area2-M-38 at 0.13'	Soil	9349S003007F
073031-0002	Area2-M-38 at 1.13'	Soil	9349S003008F
073031-0003	Area2-M-38 at 2.13'	Soil	9349S003009F
073031-0004	Area2-S-19 at 0.13'	Soil	9349S003010F
073031-0005	Area2-S-19 at 0.88'	Soil	9349S003011F
073031-0006	Area2-S-19 at 2.25'	Soil	9349S003012F
073031-0007	M-41 Area2-M-1 at 0.13'	Soil	9349Y003035F
073031-0008	M-41 Area2-M-1 at 1.25'	Soil	9349Y003036F
073031-0009	M-41 Area2-M-1E at 2.25'	Soil	9349Y003037F

**Table D-1. Samples Collected from Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California**

Lab Number	Station Number	Sample Type	Sample Number
073115-0001	Control-S-31 at 0.13'	Leachate	9348T003042FSR
073115-0002	Control-S-31 at 2.25'	Leachate	9348T003046FSR
73115-0003	Control-S-31 at 0.88'	Leachate	9348T003044FSR
073115-0004	Area2-E-35 at 0.33'	Leachate	9348T003056FSR
073115-0005	Area2-E-35 at 1.75'	Leachate	9348T003058FSR
073115-0006	Area2-E-35 at 0.13'	Leachate	9348T003054FSR
073115-0007	Area2-I-35 at 1.75'	Leachate	9348T003064FSR
073115-0008	Area2-I-35 at 0.29'	Leachate	9348T003062FSR
073115-0009	Area2-I-35 at 0.08'	Leachate	9348T003060FSR
073115-0010	Area1-M-2 at 2.25'	Leachate	9348T003020FSR
073115-0011	Area1-M-2 at 6.25'	Leachate	9348T003022FSR
073115-0012	Area1-M-2 at 0.13'	Leachate	9348T003075FSR
073115-0013	Area1-U-6 at 0.92'	Leachate	9348T003006FSR
073115-0014	Area1-U-6 at 0.13'	Leachate	9348T003004FSR
073115-0015	Area1-U-6 at 2.75'	Leachate	9348T003008FSR
073115-0016	Control-S-31 at 0.13'	Leachate	9348T003042FSS
073115-0017	Control-S-31 at 2.25'	Leachate	9348T003046FSS
073115-0018	Control-S-31 at 0.88'	Leachate	9348T003044FSS
073115-0019	Area2-E-35 at 0.33'	Leachate	9348T003056FSS
073115-0020	Area2-E-35 at 1.75'	Leachate	9348T003058FSS
073115-0021	Area2-E-35 at 0.13'	Leachate	9348T003054FSS
073115-0022	Area2-I-35 at 1.75'	Leachate	9348T003064FSS
073115-0023	Area2-I-35 at 0.29'	Leachate	9348T003062FSS
073115-0024	Area2-I-35 at 0.08'	Leachate	9348T003060FSS
073115-0025	Area1-M-2 at 2.25'	Leachate	9348T003020FSS
073115-0026	Area1-M-2 at 6.25'	Leachate	9348T003022FSS
073115-0027	Area1-M-2 at 0.13'	Leachate	9348T003075FSS
073115-0028	Area1-U-6 at 0.92'	Leachate	9348T003006FSS
073115-0029	Area1-U-6 at 0.13'	Leachate	9348T003004FSS
073115-0030	Area1-U-6 at 2.75'	Leachate	9348T003008FSS
073677-0001	Control-S-31 at 0.13'	Leachate	9348T003042FUR
073677-0002	Control-S-31 at 2.25'	Leachate	9348T003046FUR
073677-0003	Control-S-31 at 0.88'	Leachate	9348T003044FUR
073677-0004	Area2-E-35 at 0.33'	Leachate	9348T003056FUR
073677-0005	Area2-E-35 at 1.75'	Leachate	9348T003058FUR

**Table D-1. Samples Collected from Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California**

Lab Number	Station Number	Sample Type	Sample Number
073677-0006	Area2-E-35 at 0.13'	Leachate	9348T003054FUR
073677-0007	Area2-I-35 at 1.75'	Leachate	9348T003064FUR
073677-0008	Area2-I-35 at 0.29'	Leachate	9348T003062FUR
073677-0009	Area2-I-35 at 0.08'	Leachate	9348T003060FUR
073677-0010	Area1-M-2 at 2.25'	Leachate	9348T003020FUR
073677-0011	Area1-M-2 at 6.25'	Leachate	9348T003022FUR
073677-0012	Area1-M-2 at 0.13'	Leachate	9348T003075FUR
073677-0013	Area1-U-6 at 0.92'	Leachate	9348T003006FUR
073677-0014	Area1-U-6 at 0.13'	Leachate	9348T003004FUR
073677-0015	Area1-U-6 at 2.75'	Leachate	9348T003008FUR
073677-0016	Control-S-31 at 0.13'	Leachate	9348T003042FUS
073677-0017	Control-S-31 at 2.25'	Leachate	9348T003046FUS
073677-0018	Control-S-31 at 0.88'	Leachate	9348T003044FUS
073677-0019	Area2-E-35 at 0.33'	Leachate	9348T003056FUS
073677-0020	Area2-E-35 at 1.75	Leachate	9348T003058FUS
073677-0021	Area2-E-35 at 0.13'	Leachate	9348T003054FUS
073677-0022	Area2-I-35 at 1.75'	Leachate	9348T003064FUS
073677-0023	Area2-I-35 at 0.29'	Leachate	9348T003062FUS
073677-0024	Area2-I-35 at 0.08'	Leachate	9348T003060FUS
073677-0025	Area1-M-2 at 2.25'	Leachate	9348T003020FUS
073677-0026	Area1-M-2 at 6.25'	Leachate	9348T003022FUS
073677-0027	Area1-M-2 at 0.13'	Leachate	9348T003075FUS
073677-0028	Area1-U-6 at 0.92'	Leachate	9348T003006FUS
073677-0029	Area1-U-6 at 0.13'	Leachate	9348T003004FUS
073677-0030	Area1-U-6 at 2.75'	Leachate	9348T003008FUS
074061-0001	1A-FILT-001	Filter	9342P003001F
074061-0002	1A-FILT-002	Filter	9342P003002F
074061-0003	1C-FILT-003	Filter	9342P003003F
074061-0004	1A-FILT-004	Filter	9343P003001F
074061-0005	1A-FILT-005	Filter	9343P003002F
074061-0006	1C-FILT-006	Filter	9343P003003F
074061-0007	1B-FILT-007	Filter	9343P003004F
074061-0008	1A-FILT-008	Filter	9343P003005F
074061-0009	1C-FILT-009	Filter	9343P003006F
074061-0010	1B-FILT-010	Filter	9343P003007F

**Table D-1. Samples Collected from Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California**

Lab Number	Station Number	Sample Type	Sample Number
074061-0011	1A-FILT-011	Filter	9343P003008F
074061-0012	1B-FILT-012	Filter	9343P003009F
074061-0013	1C-FILT-013	Filter	9343P003010F
074061-0014	1A-FILT-014	Filter	9344R003001F
074061-0015	1B-FILT-015	Filter	9344R003002F
074061-0016	1C-FILT-016	Filter	9344R003003F
074061-0017	1A-FILT-017	Filter	9344R003004F
074061-0018	1B-FILT-018	Filter	9344R003005F
074061-0019	1C-FILT-019	Filter	9344R003006F
074061-0020	1A-FILT-020	Filter	9344P003011F
074061-0021	1B-FILT-021	Filter	9344P003012F
074061-0022	1C-FILT-022	Filter	9344P003013F
074061-0023	1A-FILT-023	Filter	9344P003014F
074061-0024	1B-FILT-024	Filter	9344P003015F
074061-0025	1C-FILT-025	Filter	9344P003016F
074061-0026	1A-FILT-026	Filter	9344P003017F
074061-0027	1B-FILT-027	Filter	9344P003018F
074061-0028	1C-FILT-028	Filter	9344P003019F
074061-0029	1A-FILT-029	Filter	9345P003020F
074061-0030	1B-FILT-030	Filter	9345P003021F
074061-0031	1C-FILT-031	Filter	9345P003022F
074061-0032	Field Blank	Filter	9345P003023C

Note: First six digits report the SDG number.

APPENDIX E

APPENDIX E

**ASTM METHOD D 4793-88
STANDARD TEST METHOD FOR SEQUENTIAL
BATCH EXTRACTION OF WASTE WITH WATER**

1991



ANNUAL BOOK OF ASTM STANDARDS



Water and Environmental Technology



VOLUME
11.04

Pesticides; Resource Recovery;
Hazardous Substances and Oil
Spill Responses; Waste Disposal;
Biological Effects

Includes standards of the following committees:

D-34 on Waste Disposal
E-35 on Pesticides
E-47 on Biological Effects and Environmental Fate
E-48 on Biotechnology
F-20 on Hazardous Substances and Oil Spill Re-
sponse

Publication Code Number (PCN), 01-110491-48



Standard Test Method for Sequential Batch Extraction of Waste with Water¹

This standard is issued under the fixed designation D 4793; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method is a procedure for the sequential leaching of a waste containing at least five % solids to generate solutions to be used to determine the constituents leached under the specified testing conditions.

1.2 This test method calls for the shaking of a known weight of waste with water of a specified purity and the separation of the aqueous phase for analysis. The procedure is conducted ten times in sequence on the same sample of waste, and generates ten aqueous solutions.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 75 Practice for Sampling Aggregates²

D 420 Practice for Investigating and Sampling of Soil and Rock for Engineering Purposes³

D 1129 Terminology Relating to Water⁴

D 1193 Specification for Reagent Water⁴

D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures³

D 2234 Method for Collection of a Gross Sample of Coal⁵

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D-19 on Water⁴

D 3370 Practices for Sampling Water⁴

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process⁶

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, see Terminology D 1129.

3.2 Symbols:

3.2.1 Variables listed in this test method are defined in the individual sections where they are discussed. A list of defined

variables is also given in Section 11.

3.2.2 Explanation of Variables:

\bar{X}_t = total mean value

\bar{X}_a = analytical mean value (calculated using data from analysis of standards)

S_{tt} = total standard deviation

S_{ta} = analytical standard deviation

S_{te} = estimated standard deviation due to the extraction procedure

S_{ot} = total single operator standard deviation

S_{oa} = analytical single operator standard deviation

S_{oe} = estimated single operator standard deviation due to the extraction procedure

4. Significance and Use

4.1 This test method is intended as a means for obtaining sequential extracts of a waste. The extracts may be used to estimate the release of certain constituents of the waste under the laboratory conditions described in this test method.

4.2 This test method is not intended to provide extracts that are representative of the actual leachate produced from a waste in the field or to produce extracts to be used as the sole basis of engineering design.

4.3 This test method is not intended to simulate site-specific leaching conditions. It has not been demonstrated to simulate actual disposal site leaching conditions.

4.4 An intent of this test method is that the final pH of each of the extracts reflect the interaction of the extractant with the buffering capacity of the waste.

4.5 An intent of this test method is that the water extractions reflect conditions where the waste is the dominant factor in determining the pH of the extracts.

4.6 This test method produces extracts that are amenable to the determination of both major and minor constituents. When minor constituents are being determined, it is especially important that precautions are taken in sample storage and handling to avoid possible contamination of the samples.

4.7 This test method has been tested to determine its applicability to certain inorganic components in the waste. This test method has not been tested for applicability to organic substances and volatile matter (see 5.11).

4.8 The agitation technique, rate, liquid-to-solid ratio, and filtration conditions specified in the procedure may not be suitable for extracting all types of wastes (see Sections 7, 8, and the discussion in Appendix X1).

5. Apparatus

5.1 *Two Drying Pans or Dishes* per waste (for example, aluminum tins, porcelain dishes, glass weighing pans) suit-

¹ This test method is under the jurisdiction of ASTM Committee D-34 on Waste Disposal and is the direct responsibility of Subcommittee D34.02 on Physical and Chemical Characterization.

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² Annual Book of ASTM Standards, Vol 04.03

³ Annual Book of ASTM Standards, Vol 04.08

⁴ Annual Book of ASTM Standards, Vol 11.01.

⁵ Annual Book of ASTM Standards, Vol 05.05.

⁶ Annual Book of ASTM Standards, Vol 14.02.

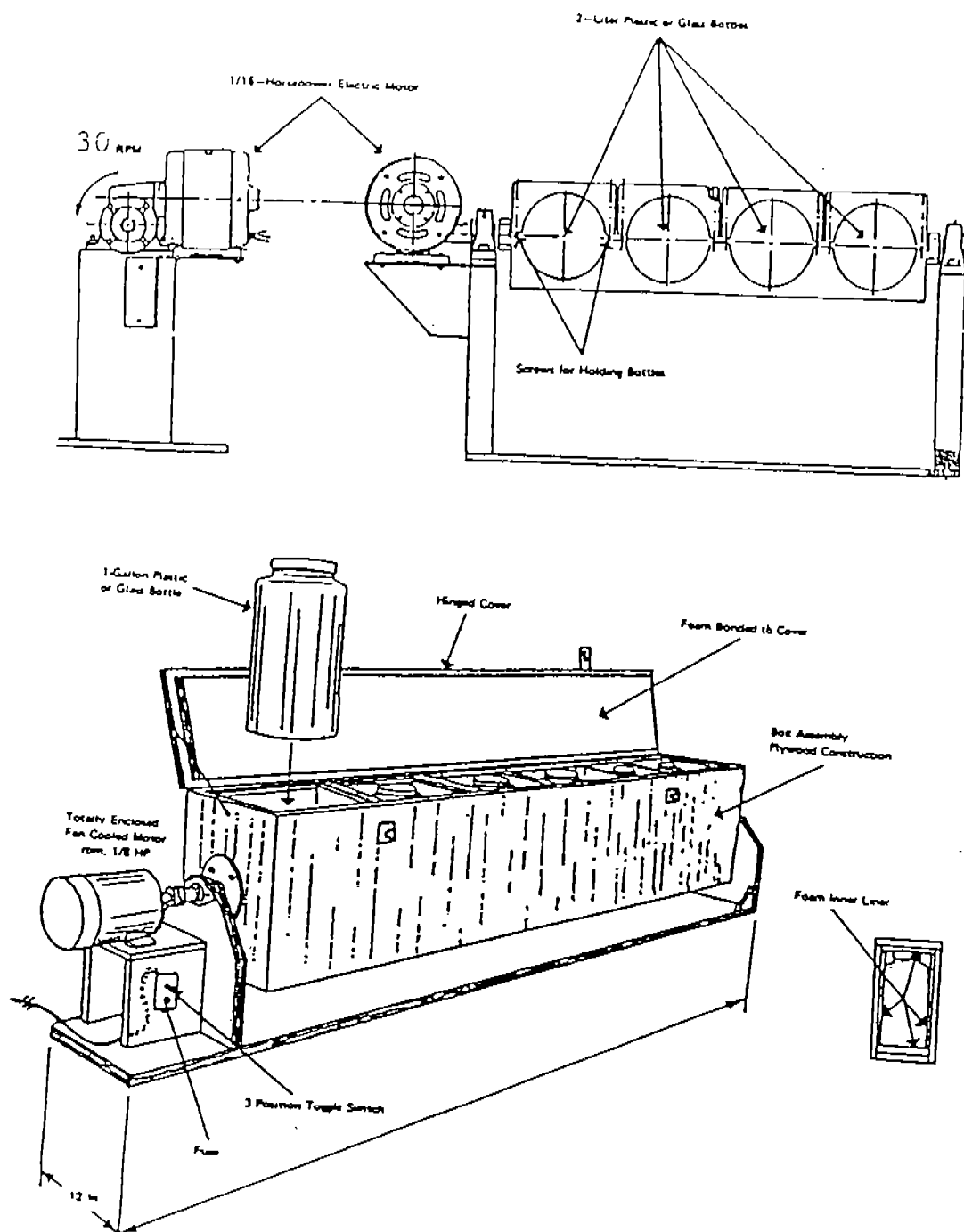


FIG. 1 Extractors

able to the waste being tested and the instructions given in 9.2.

- 5.2 Drying Oven.
- 5.3 Desiccator.
- 5.4 Laboratory Balance capable of weighing to 0.1 g.
- 5.5 Pipet, 10-mL capacity.
- 5.6 Two Crucibles per waste, porcelain, 20-mL capacity each.
- 5.7 Analytical Balance capable of weighing to 0.1 mg.
- 5.8 Large Glass Funnel.

5.9 Agitation Equipment, of any type that rotates about central axis at a rate of 30 ± 2 r/min, (see Fig. 1 for discussion of agitation in Appendix X1).

5.10 Pressure Filtration Assembly, TFE-fluorocarbon coated stainless steel pressure device equipped with a 0.4 μ m cellulose membrane filter.

5.11 Extraction Vessels, round, wide-mouth, of a composition suitable to the nature of the waste and analyses to be performed, and constructed of materials that will not allow sorption of constituents of interest. Container size should be selected so that the sample plus test water occupy approx

mately 95 % of the container. Containers must have a water tight closure. Containers for samples where gases may be released should be provided with a venting mechanism.

NOTE 1—The venting of the container has the potential to affect the concentration of volatile compounds in the extracts. Containers should be cleaned in a manner consistent with the analyses to be performed.

6. Reagents

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the American Chemical Society, where such specifications are available.⁷ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean Type IV reagent water at 18 to 27°C (Specification D 1193). The method by which the water is prepared, that is, distillation, ion exchange, reverse osmosis, electrodialysis, or a combination thereof, should remain constant throughout testing.

7. Sampling

7.1 Obtain a representative sample of the waste to be tested using ASTM sampling methods developed for the specific industry where available (see Practices D 75 and D 420 and Method D 2234).

7.2 Where no specific methods are available, sampling methodology for material of similar physical form shall be used.

7.3 A minimum sample of 5000 g shall be sent to the laboratory (see Practice E 122).

7.4 It is important that the sample of the waste be representative with respect to surface area, as variations in surface area would directly affect the leaching characteristics of the sample. Waste samples should contain a representative distribution of particle sizes.

7.5 Keep samples in closed containers appropriate to the sample type prior to the extraction in order to prevent sample contamination or constituent loss. Where it is desired to extract biologically or chemically active samples in their existing state, store the samples at 4°C (Practices D 3370) and start the extraction within 8 h. Where it is desired to extract such samples in a state representative of the results of biological or chemical activities, the samples may be specifically handled to simulate such activities. Record the storage conditions and handling procedures in the report.

8. Sample Preparation

8.1 For free-flowing particulate solid wastes, obtain a sample of the approximate size required in the test by quartering the sample (Section 7) received for testing on an impermeable sheet of glazed paper, oil cloth, or other flexible material as follows:

8.1.1 Empty the sample container into the center of the sheet.

8.1.2 Flatten out the sample gently with a suitable straightedge until it is spread uniformly to a depth at least twice the maximum particle diameter.

8.1.3 Remix the sample by lifting a corner of the sheet and drawing it across, low down, to the opposite corner in a manner that the material is made to roll over and over and does not merely slide along. Continue operation with each corner, proceeding in a clockwise direction. Repeat this operation ten times.

8.1.4 Lift all four corners of the sheet towards the center and holding all four corners together, raise the entire sheet into the air to form a pocket for the sample.

8.1.5 Repeat 8.1.2.

8.1.6 With a straightedge (such as a thin-edged yard stick), on at least as long as the flattened mound of sample, gently divide the sample into quarters. Make an effort to avoid using pressure on the straightedge sufficient to cause damage to the particles.

8.1.7 Discard alternate quarters.

8.1.8 If further reduction of sample size is necessary, repeat 8.1.3 through 8.1.7. Use a sample size to give 100 g of solid for each extraction. Provide additional samples for determination of solids content. If smaller samples are used in the test, report this fact.

8.2 For field-cored solid wastes or castings produced in the laboratory, cut a representative section weighing approximately 100 g for testing plus samples for determination for solids content. Shape the sample so that the leaching solution will cover the material to be leached.

8.3 For multiphasic wastes, mix thoroughly to ensure that a representative sample will be withdrawn. Take samples for determination of solids content at the same time as the test samples.

9. Procedure

9.1 Record the physical description of the sample to be tested including particle size so far as it is known.

9.2 *Solids Content*—Determine the solids content of two separate portions of the sample as follows:

9.2.1 Dry to a constant weight at $104 \pm 2^\circ\text{C}$ two dishes or pans of size suitable to the solid waste being tested. Cool in a dessicator and weigh. Record the values to ± 0.1 g.

9.2.2 Put an appropriately sized portion of sample of the waste to be tested into each pan. Scale the weight used to the physical form of the waste tested. Use a minimum of 50 g but use larger samples where particles larger than 10 mm in average diameter are being tested. Weigh. Record the mass to ± 0.1 g.

9.2.3 Dry 16 to 20 h at $104 \pm 2^\circ\text{C}$. Record the temperature and time of the drying period.

9.2.4 Cool to room temperature in a dessicator and reweigh. Record the mass to ± 0.1 g.

9.2.5 Repeat steps 9.2.3 and 9.2.4 until constant container-sample masses are obtained. Discard the dried samples following completion of this step.

9.2.6 Calculate the solids content of the sample from the data obtained in 9.2.2 and 9.2.4 as follows:

$$S = A/B \quad (1)$$

where:

⁷ "Reagent Chemicals, American Chemical Society Specifications." Am. Chemical Soc., Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."

A = mass of sample after drying, g,
 B = original mass of sample, g, and
 S = solids content, g/g.

Average the two values obtained. Record the solids content.

9.3 Extraction Procedure—Determine the mass of the extraction vessel to be used in the extraction procedure to the nearest 0.1 g. Record the mass of the extraction vessel, M_{v1} . Use one extraction vessel per waste throughout the sequence of extractions.

9.3.1 Add 100 g (weighed to ± 0.1 g) of solid waste on a dry weight basis to the extraction vessel. Calculate the amount of waste as received to add using the equation:

$$M = \frac{100}{S} \quad (2)$$

where:

M = mass of waste as received to add to the extraction vessel to give 100 g (weighed to ± 0.1 g) of solid waste.

9.3.2 Add a volume in mL, V_{v1} , of test water (see 6.2) to the extraction vessel determined using the equations:

$$M_{sw} = M - 100 \quad (3)$$

where:

M_{sw} = mass of moisture (g) in the sample added to the extraction vessel, and

$$V_{v1} = 2000 - M_{sw} \quad (4)$$

9.3.3 Agitate continuously for 18 ± 0.25 h at 18 to 27°C. Record the agitation time and temperature.

9.3.4 Open the extraction vessel. Observe and record any visible physical changes in the sample and leaching solution. Record the pH of the waste/leaching solution slurry.

9.4 Filtration—Transfer as much of the waste/leaching solution as possible through a large glass funnel to a pressure filtration device equipped with a 0.45- μ m cellulose membrane filter. Transfer the mixed slurry. Do not decant. Invert the extraction vessel over the filtration device and allow the liquid to drain from the solid remaining in the extraction vessel for 1 min. It is important to achieve as complete a transfer of fluid from the extraction vessel to the filtration device as possible. Pressure filter the liquid through the 0.45- μ m filter using nitrogen gas. After the extract has passed through the filter, continue running nitrogen gas through the filtration device at 30 psi for 3 min. The filtrate obtained is the extract mentioned in this test method (see 9.5 and 10.8). Determine the volume of the filtrate collected and report it as V for that extraction step. Measure the pH of the extract immediately, remove the volume of filtrate necessary for determination of total dissolved solids content in 9.5, and then preserve the extract in a manner consistent with the chemical analyses or biological testing procedures to be performed (Practices D 3370).

9.5 Total Dissolved Solids Content, (TDS)—Pipette two 10.0-mL samples of the extract and transfer each to a dried, preweighed crucible (weighed to ± 0.1 mg). Place the samples in a drying oven at 110°C for 3 h. Record the drying oven temperature and drying time. Remove the crucibles and let cool in a desiccator. Reweigh the crucibles and record their weights to ± 0.1 mg.

NOTE 3—Only one drying is performed to limit the contact time between the solid and the rinse water in the extraction vessel prior to the next extraction step (see 9.6, 9.7, and 9.8).

9.6 Quantitatively transfer the damp solid from the filter back to the original extraction vessel, including the 0.45- μ m membrane filter. Use water (see 6.2) from a pre-weighed wash bottle to assist in this transfer and to rinse the filtration device. No more than 500 mL of water should be used rinsing. Use the smallest volume of wash water possible to achieve a thorough transfer. Using tweezers or a similar device, recover the 0.45- μ m membrane filter and rinse adhering solid into the extraction vessel with water from a pre-weighed wash bottle. Do not leave the filter in the extraction vessel. Reweigh the wash bottle to determine amount of water used in the transfer. Record this value M_w . Weigh the extraction vessel following the transfer described above and record this value as M_v . The extraction vessel may be sealed until a feasible time for addition of new extraction fluid. This is to enable filtration during the next sequence at a reasonable time during the day. If the slurry is stored for longer than 6 h in the extraction vessel prior to addition of new extraction fluid, the data generated by analysis of the extracts should be plotted to check for perturbation of the data curve.

10. Calculation

10.1 Calculate the total dissolved solids contents, TDS, in milligrams per litre of the filtrate using the following equation:

$$TDS = (M_{sc} - M_c)(100)$$

where:

M_{sc} = mass of the crucible and dried solids, mg and
 M_c = mass of the crucible, mg.

10.2 Calculate the mass of the solid in grams lost through dissolution, M_d , using the following equation:

$$M_d = (TDS)(V)(.001)$$

where:

V = volume of filtrate collected in that extraction, L, and
 M_d = mass loss through dissolution.

10.3 Calculate the mass of the solid corrected for TDS remaining for the next extraction step, M_s , using the following equation:

$$M_s = M_s^{e-1} - M_d$$

where:

M_s^{e-1} = mass of the solid extracted in the current extraction step, g.

NOTE 3—For example in beginning the first extraction, M_s^{e-1} will equal 100 g and to calculate the mass of solid remaining for the second extraction step, M_s will equal $100 \text{ g} - M_d$.

10.4 Calculate the combined mass of the solid and residual liquid in the extraction vessel, M_{st} , using the following equation:

$$M_{st} = M_v - M_{v1} - M_w$$

10.5 Calculate the mass of liquid adhering to the solids in the extraction vessel, M_l , using the equation:

$$M_l = M_{st} - M_s$$

10.6 Calculate the volume in millilitres of new test water to be added to the extraction vessel, Test Water Volume (TWV), using the following equation:

$$TWV = [(M_s)(20)] - M_l - M_w \quad (1)$$

10.7 Add to the extraction vessel the amount of new test

water, TWV, determined in 10.6 and repeat 9.3.3 through 10.7 so that ten extractions are done in sequence.

Note 4—This procedure assumes that the amount of waste that is trapped in the filters after rinsing is negligible.

10.8 Analyze the extracts for specific constituents or properties or use the extracts for biological testing procedures as desired using appropriate ASTM standard methods. Where no appropriate ASTM methods exist, other methods may be used and recorded in the report. Where phase separation occurs during the storage of the extracts, appropriate mixing should be used to ensure the homogeneity of the extracts prior to their use in such analyses or testing.

10.9 *Compensation for Carry-Over*—For each constituent in each of the extracts generated in the extraction sequence, the contribution to concentration from the residual liquid from the previous extraction step, C_j , can be calculated using the equation:

$$C_j = [M_{li}/20(M_s^{\leftarrow 1})][C_i] \quad (11)$$

where:

C_i = concentration of the constituent in the filtrate from the previous extraction step,
 M_j = M_i from the previous extraction step, and
 $M_s^{\leftarrow 1}$ = mass of solid extracted in the current extraction step (see Note 3).

11. Definition of Variables

11.1 The following variables must be determined when performing the sequential batch extraction procedure:

11.1.1 Solids Content Determination:

A = the mass of the sample after drying in the determination of the solids content of the waste to be extracted, g,
 B = the original mass of the sample prior to drying in the determination of the solids content of the waste to be extracted, g, and
 S = the solids content of the waste to be extracted, g/g.

11.1.2 First Extraction Step:

M = the mass of waste as received added to the extraction vessel to give 100 g (weighted to ± 0.1 g) of solid on a dry weight basis for the first extraction step, g,
 V_w = the volume of test water to be added for the first step in the extraction procedure, mL, and
 M_{tw} = the mass of the moisture in the sample to be extracted in the first extraction step, g.

11.1.3 TDS Determination:

TDS = the total dissolved solids content of the filtrate, mg/L,
 M_c = the mass of the crucible to be used in the TDS determination, mg, and
 M_{sc} = the mass of the crucible and dried solids in the TDS determination, mg.

11.1.4 Extraction Sequence:

M_d = the mass of the solid lost through dissolution during extraction, g,
 V = the volume of filtrate collected in that extraction, L,
 M_s = the mass of the solid remaining for the next extraction step, g,
 $M_s^{\leftarrow 1}$ = the mass of the solid extracted in the current extraction step, g,
 M_{v1} = the mass of the empty extraction vessel, g,
 M_w = the mass of the rinse water, g,
 M_v = the combined mass of the extraction vessel, rinse water, solid and moisture in the solid, and solid and liquid left in the extraction vessel after transfer to the filtering device, g,
 M_{sl} = the combined mass of the solid and the residual liquid in the extraction vessel following transfer of the moist sample cake back to the extraction vessel, g,
 M_l = the mass of the liquid adhering to the solids in the extraction vessel following transfer of the moist sample cake back to the extraction vessel, g, and
TWV = the volume of test water to be added for the next extraction step, mL.

11.1.5 Compensation for Carry-Over:

C_j = the contribution to an constituent's concentration in the current step from the residual liquid of the previous extraction step, mg/L,
 M_{li} = the M_i from the previous extraction step, g,
 $M_s^{\leftarrow 1}$ = the mass of solid extracted in the current step, g, and
 C_i = the concentration of the constituent in the filtrate from the previous extraction step, mg/L.

12. Report

12.1 Report the following information:

- 12.1.1 Source of the waste, date of sampling, method of sampling, method of sample preservation, storage conditions, and handling procedures,
- 12.1.2 Description of the waste including physical characteristics and particle size, if known (9.1),
- 12.1.3 Solids content (9.2) (see Test Method D 2216),
- 12.1.4 Mass of solid waste extracted if other than 100 g (8.1.8),
- 12.1.5 Time and temperature used in the determination of solids content and TDS,
- 12.1.6 Agitation temperature and time,
- 12.1.7 Filter used if other than 0.45- μ m cellulose membrane,
- 12.1.8 Observations of changes in test material or leaching solutions (9.3.4),
- 12.1.9 pH before and after filtration and results of specific analyses calculated in appropriate units and corrected for carry-over if necessary,
- 12.1.10 Dates sequential batch extraction started and completed, preservation used for extracts, and date of analyses.

Note 5—Fig. 2 presents a report format for recording some of the experimental data.

Sample Number: _____

In Generating Extract Number	TDS (mg/L)	V (L)	M _d (g)	M _s (g)	M _v (g)	M _{vl} (g)	M _w (g)	M _{sl} (g)	M _j (g)	i
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

FIG. 2 Sequential Batch Procedure Data Sheet

13. Precision and Bias⁸

13.1 Precision:

13.1.1 A collaborative study of this test method involving eight laboratories was conducted. Each laboratory extracted a single sample in duplicate. The extracts generated in the first, third, fifth, seventh, and tenth extraction steps were analyzed by each participant and by a reference laboratory. In addition, three standards containing high, medium, and low concentrations of the elements of interest, aluminum, calcium, copper, iron, magnesium, nickel, and zinc were analyzed by each participant in triplicate in order to determine the analytical precision. From the data generated, precision calculations were performed using Practice D 2777 as a guideline.

13.1.2 Three types of precision can be determined from the data generated. These are the total standard deviation, S_{tt} , the analytical standard deviation, S_{ia} , and the estimated standard deviation of the extraction procedure, S_{te} . The standard deviations calculated using the data generated by the individual laboratories from their analyses of the extracts are due to a combination of both the extraction procedure and the analytical errors (S_{tt}). The precision data determined from the analyses of the high, medium, and low standards present those values due to analytical error only (S_{ia}), and the standard deviation of the extraction procedure represents

the estimated error due only to the extraction method (S_{te}). The estimated standard deviation of the extraction procedure for each element of interest in extracts 1, 3, 5, 7, and 9 was calculated using the equation:

$$S_{te} = (S_{tt}^2 - S_{ia}^2)^{1/2}$$

These values along with the total and analytical mean values (\bar{X}_t and \bar{X}_a) and standard deviations are listed in Table 1.

13.1.3 The three types of precision values discussed in 13.1.2, total, analytical, and extraction procedure, can all be calculated based on a single operator. Calculations were performed to determine the total single operator precision, S_{ot} , the single operator analytical standard deviation, S_{oa} , and the single operator estimated standard deviation of the extraction procedure, S_{oe} . The single operator estimated standard deviation of the extraction procedure was calculated using the equation:

$$S_{oe} = (S_{ot}^2 - S_{oa}^2)^{1/2}$$

The single operator precision values are listed in Table 2.

13.1.4 The estimated precision of this sequential batch extraction procedure varies with the concentration of each of the seven constituents of interest in the collaborative study according to Figs. 3 to 9. These are plots of the estimated percent relative standard deviation of the extraction method versus total mean concentration of the constituent.

13.1.5 For the concentration values determined in the third, fifth, seventh, and tenth extracts, there does not appear to be a relationship between elemental concentration and estimated precision of the extraction procedure. Because of the very limited data at higher concentrations, it cannot be

⁸ Supporting data for the precision statement and concerning analytical bias have been filed at ASTM Headquarters and may be obtained by requesting RR:D34.1005.

mined if such a trend exists at higher concentration however, the estimated precision of the extraction procedure is generally best for the elemental concentration values determined in the first extract.

13.1.6 These collaborative test data were obtained through the extraction of a raw oil shale sample. For other materials, these data may not apply.

13.1.7 The estimated precision of the extraction procedure includes the increase in variability that may be attributable to field collection, laboratory crushing and sample

splitting, and distribution of split samples to the various laboratories for testing. The analytical precision was calculated using data determined for the standard solutions, and as a result, does not include variability due to various liquid matrices.

13.2 *Bias*—Determination of the bias of this test method is not possible, as no standard reference material exists. Information concerning the analytical bias determined from the collaborative study of this procedure is available in Research Report D34.1005.

TABLE 1 Sequential Batch Extraction Round-Robin Study
Statistical Data Summarized—Estimated Total Precision of the
Extraction Procedure ($\mu\text{g/g}$)

Extract 1	Alumi- num	Cal- cium	Cop- per	Iron	Mag- nesium	Nickel	Zinc
\bar{X}_t	75.4	982.0	12.3	68.2	189.0	63.3	237.0
S_{σ}	10.1	286.0	2.69	9.49	19.6	6.52	25.3
\bar{X}_a	54.2	1072.0	2.25	55.2	190.0	55.3	186.0
$S_{\sigma a}$	5.03	326.0	0.260	4.24	16.4	4.56	20.1
$S_{\sigma e}$	8.75	...	2.65	8.49	10.7	4.66	15.4
Extract 3							
\bar{X}_t	10.5	72.1	0.990	1.87	7.78	2.74	11.3
S_{σ}	9.20	30.6	1.06	0.404	2.32	1.05	5.24
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.765	1.67	0.260	0.450	0.327	0.331	0.183
$S_{\sigma e}$	9.17	30.6	0.950	...	2.30	0.996	5.24
Extract 5							
	6.23	52.8	0.322	1.85	4.73	2.01	8.46
	2.17	12.4	0.100	0.516	1.09	0.470	2.38
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.765	1.67	0.260	0.450	0.327	0.331	0.183
$S_{\sigma e}$	2.03	12.3	...	...	1.04	0.333	2.37
Extract 7							
\bar{X}_t	5.13	52.7	0.416	1.53	3.95	1.59	6.65
S_{σ}	1.90	4.86	0.089	0.730	1.47	0.270	0.652
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.765	1.67	0.260	0.450	0.327	0.331	0.183
$S_{\sigma e}$	1.74	4.56	...	0.455	1.43	...	0.626
Extract 10							
\bar{X}_t	1.46	62.3	0.444	1.56	2.72	1.36	6.71
S_{σ}	0.866	21.7	0.067	0.467	0.679	0.239	1.89
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.765	1.67	0.260	0.450	0.327	0.331	0.183
$S_{\sigma e}$	1.04	21.6	...	...	0.556	...	1.88

^a $S_{\sigma e}$ is too small to be statistically evident.

TABLE 2 Sequential Batch Extraction Round-Robin Study
Statistical Data Summarized—Estimated Single Operator Precision
of the Extraction Procedure ($\mu\text{g/g}$)

Extract 1	Alumi- num	Cal- cium	Cop- per	Iron	Mag- nesium	Nickel	Zinc
\bar{X}_t	75.4	982.0	12.3	68.2	189.0	63.3	237.0
S_{σ}	2.31	28.0	0.687	0.877	7.90	2.03	7.19
\bar{X}_a	54.2	1072.0	2.25	55.2	190.0	55.3	186.0
$S_{\sigma a}$	1.82	26.2	0.260	1.83	5.05	2.30	3.84
$S_{\sigma e}$	1.42	9.88	0.636	...	6.07	...	6.08
Extract 3							
\bar{X}_t	10.5	72.1	0.990	1.87	7.78	2.74	11.3
S_{σ}	0.678	5.26	0.080	0.437	1.07	0.094	0.622
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.098	0.666	0.260	0.450	0.288	0.110	0.097
$S_{\sigma e}$	0.671	5.22	...	...	1.03	...	0.614
Extract 5							
\bar{X}_t	6.23	52.8	0.322	1.85	4.73	2.01	8.46
S_{σ}	1.46	12.7	0.000	0.266	0.987	0.160	0.810
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.098	0.666	0.260	0.450	0.288	0.110	0.097
$S_{\sigma e}$	1.46	12.7	...	...	0.944	0.116	0.804
Extract 7							
\bar{X}_t	5.13	52.7	0.416	1.53	3.95	1.59	6.65
S_{σ}	0.865	2.17	0.100	0.255	0.385	0.319	0.535
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.098	0.666	0.260	0.450	0.288	0.110	0.097
$S_{\sigma e}$	0.859	2.06	...	...	0.255	0.299	0.526
Extract 10							
\bar{X}_t	1.46	62.3	0.444	1.56	2.72	1.36	6.71
S_{σ}	0.955	8.40	0.032	0.308	0.188	0.235	0.968
\bar{X}_a	2.50	19.9	2.25	2.70	2.33	2.22	2.28
$S_{\sigma a}$	0.098	0.666	0.260	0.450	0.288	0.110	0.097
$S_{\sigma e}$	0.950	8.37	...	...	...	0.208	0.963

^a $S_{\sigma e}$ is too small to be statistically evident.

APPENDIX F
RESPONSE TO AGENCY COMMENTS

**Response to Agency Comments
Draft Basewide Remedial Investigation/Feasibility Study
Volume II - Site 3 Remedial Investigation
Fort Ord, California**

The following are the Army's responses to the comments of the regulatory agencies on the Draft Basewide Remedial Investigation/Feasibility Study. All comments and the associated responses pertaining to Volume II, Site 3, of the Basewide Remedial Investigation/Feasibility Study are provided below.

I. U.S. ENVIRONMENTAL PROTECTION AGENCY TECHNICAL REVIEW COMMENTS

Analysis of Conclusions and Recommendations

Comment 1: The conclusion and recommendation concerning groundwater contamination by lead are not well supported. First, the data on leachability of lead at Site 3 is interpreted in this report to suggest that the potential for groundwater contamination by lead is low; however, this data could equally well suggests that infiltration of rainfall could well contribute to groundwater contamination. Second, the recommendation for no groundwater monitoring is based on little or no actual groundwater data as presented in this report. See Specific Comment 10 for details.

Response: The response to this comment is covered in detail under the response to EPA Specific Comment 10.

General Comments

Comment 1: The assessment of data quality is not complete and should include a discussion of whether the data quality objectives, bulleted in Section 4.4, were met. Moreover, field quality control sample results should be included when assessing data quality.

Response: The data quality objectives of the Site 3 investigation bulleted in Section 4.4 were met. Soil chemical data were collected and evaluated. These data indicated that a release of heavy metals, primarily lead, has occurred as a result of the weathering of spent ammunition present at the site (Section 4.1). Visual mapping of spent ammunition correlated with soil chemical data were used to assess the horizontal and vertical extent of contamination (Section 6.0). In addition to these data, air samples were collected and additional soil and plant samples were collected to perform a site-specific Human Health Risk Assessment (Volume III of this report) and Ecological Risk Assessment (Volume IV of this report). The Human Health Risk Assessment included a list of, and the process for selecting, primary chemicals of concern at Site 3. In addition, physical soil data including cation exchange capacity, TOC, and pH were collected to assess fate and transport properties of site soils (Section 6.2). Additional language has been added to the text in Section 4.4 to address this comment.

Comment 2: This RI report lacks a discussion of the fate and transport of contaminants. A fate and transport section should discuss the potential routes of contaminant migration, contaminant persistence in the environment, and contaminant migration for the chemicals detected in the remedial investigation.

Response: A fate and transport section has been added to the report, Section 6.2.

Comment 3: This RI report lacks an assessment of whether there are additional data needs, or data gaps, as a result of the planned RI activities. Have all of the data required for the risk assessment and the feasibility study been collected? Has the horizontal and vertical extent of contamination been

adequately defined? Have the impacts to groundwater been adequately determined? The answers to these and other questions should be presented in a discussion of data gaps.

Response: The text has been revised to include a separate discussion of conclusions of the Site 3 RI. Additional data needs or data gaps associated with this investigation have not been identified. Sufficient data have been collected to assess the horizontal and vertical extent of contamination and perform the Risk Assessment and Feasibility Study. Potential impacts to groundwater have also been evaluated. The conclusions are presented in Section 6.0.

Specific Comments

Comment 1: Section 1.3, Page 1, first paragraph: When will the proposed reuse for Site 3 take effect? Will investigation and remedial activities be completed prior to this date?

Response: Section 1.3 has been revised to address this comment.

Comment 2: Section 1.4, Page 2, second paragraph: This discussion should identify the maximum contaminant levels (MCLs), federal or state, to which compounds detected at the site are being compared.

Response: Federal and state MCLs were reviewed and the groundwater chemical analytical data were compared to the lower of the two MCLs. The text has been revised for clarification and a table of current federal and state MCLs has been added as Table F1 of this appendix.

Comment 3: Section 2.2, Page 4, first paragraph: A figure would be helpful in identifying and locating the biological communities discussed in this section.

Response: Plates 3, 4, and 5 have been added as suggested.

Comment 4: Section 4.2.2, Page 15, second paragraph: The rationale should be provided for the leachate tests performed for lead at Site 3. Why was the American Society of Testing and Materials (ASTM) Method D4793 (88) selected rather than the waste extraction test (WET) or the toxicity characteristic leaching procedure (TCLP)? The description in Appendix E does not support the use of the ASTM test method. Appendix E states that this test method is not intended to provide extracts that are representative of the actual leachate produced from a waste in the field. It is also not intended to simulate site specific leaching conditions and it has not been demonstrated to simulate actual disposal site leachate conditions.

Response: ASTM D4793-88 was selected as the leach test method and presented in HLA's Draft Final Work Plan for the RI at Site 3 (HLA, 1993f); this was approved by the regulatory agencies prior to initiating field work. Additional language has been added to Section 4.2.2 for clarification regarding selection of this test method.

Comment 5: Section 4.2.3, Page 15, first paragraph: The background values for detected compounds should be provided in Tables 9 and 10 and in the discussions provided in this report so that the magnitude of contamination above background can be determined.

Response: Tables 9 and 10 have been revised and a discussion included in the text, Section 4.2.3, to address this comment.

Comment 6: Section 4.2.3, Page 15, fourth paragraph: How does the background value used for lead compare to the screening level presented?

Response: The screening level for lead at Site 3 has been revised to 51.8 mg/kg, which is the maximum background concentration for lead. See Section 4.2.3 of the text.

Comment 7: **Section 4.2.3.4, Page 17, third bullet:** Lead results of the leachate analyses conducted cannot be compared to the MCL for lead (Also please clarify which MCL is being used here. Provide a reference.) As indicated in comment number 4, the ASTM test method used does not simulate site specific conditions. Moreover, the MCL for lead of 0.05 mg/L is applicable if either the WET or the TCLP test was used.

Response: Text has been revised, and references comparing the MCL and the leachate results have been removed to address this comment.

Comment 8: **Section 4.4, Page 18:** The data validation assessment section should include a discussion of whether each of the data quality objectives listed were met. For example, a refined list of chemicals of concern should be included and discussed. Did the leach tests performed adequately assess fate and transport characteristics? As mentioned in the general comments, a fate and transport section was not included in this report. Were precision and accuracy objectives met?

Response: The text has been revised to state that the data quality objectives of the RI were met. These are specifically discussed in the response to EPA General Comment 3. Specific data validation procedures and goals (including precision and accuracy goals) are discussed thoroughly in Appendix D of the Site 3 RI. The list of chemicals of concern, and their selection, is presented in the Human Health Risk Assessment, Volume III of this report. The leach tests performed did not adequately address fate and transport characteristics. A fate and transport section has been added (Section 6.2).

Comment 9: **Section 4.4, Page 18, last paragraph:** Were field quality control sample data (field blanks, field duplicates, decontamination rinsates) collected during the investigation? If so, why were these data not included in the assessment of data quality?

Response: Field quality control samples were not collected during the Site 3 RI. The text has been revised to state this.

Comment 10: **Section 5.4, Page 21, first paragraph:** The conclusion that the potential for groundwater contamination by lead is low is not well supported by the arguments that are presented for the following reasons:

- a) This report states that concentrations of lead in soil greater than the 1000 mg/kg screening level were not detected below depths of two feet. However, no information was provided with how lead distribution by depth compared to the background lead level.
- b) The report states that leachate results indicated that concentrations were below the MCL of 0.5 mg/L. As mentioned in Comments 4 and 7 above, the leachate results are not representative of actual site conditions and are not directly comparable to the MCL.
- c) The results of leachate analysis are reported to indicate that metals could be leached by rainwater. There is no information provided that would indicate that rainwater infiltrating through high lead concentrations at the surface will not recharge groundwater.
- d) The report states that priority pollutant metals were not detected above MCLs in the well installed in Range 11, which is within 20 feet of a heavily bulletted dune. This reasoning is not sound because it is not known whether the well is upgradient or downgradient of the

source area and it is not known whether groundwater extracted from this well can be considered representative of groundwater conditions at the site.

- Response:
- a) The screening level has been revised to 51.8 mg/kg, the maximum background concentration for lead. Additional information was added to Section 4.2.3 comparing the vertical distribution of lead to maximum background lead concentrations at Site 3.
 - b) Text has been revised, and references comparing the leachate results with MCLs have been removed.
 - c) Extensive leaching of lead from soil has not occurred, as evidenced by the vertical distribution of lead in the soil. In addition, an evaluation of the fate and transport properties of lead indicates that soil conditions (TOC, CEC, pH, and the presence of iron oxides) favor retention of lead in site soils. Based on these data, the results for the leach tests do not appear to be representative of actual field conditions at Site 3.
 - d) Monitoring Well MW-02-10-180 is within 20 feet in a crossgradient direction of a heavily bulletted dune face, and groundwater data indicate that gradients in this area are relatively flat. Because rainwater would infiltrate through high concentrations of spent ammunition located on the dune face and because groundwater is shallowest in this area (given the topography), this well is considered to represent a worse case scenario. Neither lead nor priority pollutant metals were detected in samples collected from Monitoring Wells MW-02-02-180 and MW-02-08-180 approximately 500 feet downgradient of a heavily bulletted area in Range 9. These results suggest that groundwater has not been impacted by lead to date.

**Table F1. Federal and State Groundwater Standards
Volume II - Remedial Investigation, Basewide RI/FS
Ford Ord, California**

Chemical	CA MCL ^c (primary) (µg/l)	CA MCL ^c (secondary) (µg/l)	FED MCL ^d (primary) (µg/l)	FED MCL ^d (secondary) (µg/l)	FED MCLG ^d (primary) (µg/l)
<u>Inorganics</u>					
Antimony	NA	NA	6	NA	6
Arsenic	50	NA	50	NA	NA
Beryllium	NA	NA	4	NA	4
Cadmium	10	NA	5	NA	5
Chloride	NA	250,000	NA	250,000	NA
Chromium (total)	50	NA	100	NA	100
Copper	NA	1,000	NA(1,300) ^e	1,000	1,300
Fluoride	f	NA	4,000	2,000 ^g	4,000
Iron	NA	300	NA	300	NA
Lead	50	NA	NA(15) ^e	NA	0.0
Mercury	2	NA	2	NA	2
Nickel	NA	NA	100	NA	100
Nitrate (as N)	45,000 ^h	NA	10,000	NA	10,000
Nitrite (as N)	NA	NA	1,000	NA	1,000
Selenium	10	NA	50	NA	50
Silver	50	NA	NA	100	NA
Sulfate	NA	250,000	NA	250,000	NA
Thallium	NA	NA	2	NA	0.5
Total dissolved solids	NA	500,000	NA	500,000	NA
Zinc (total)	NA	5,000	NA	5,000	NA
pH	NA	6.5-8.3 ⁱ	NA	6.5-8.5	NA
<u>Organics</u>					
Benzene	1	NA	5	NA	0.0
Bromodichloromethane ^j	NA	NA	100	NA	NA
Bromoform ^j	NA	NA	100	NA	NA

**Table F1. Federal and State Groundwater Standards
Volume II - Remedial Investigation, Basewide RI/FS
Ford Ord, California**

Chemical	CA MCL ^c (primary) (µg/l)	CA MCL ^c (secondary) (µg/l)	FED MCL ^d (primary) (µg/l)	FED MCL ^d (secondary) (µg/l)	FED MCLG ^d (primary) (µg/l)
Bromomethane	NA	NA	NA	NA	NA
Carbon tetrachloride	0.5	NA	5	NA	0.0
Chlorobenzene	30	NA	100	NA	100
Chloroethane	NA	NA	NA	NA	NA
2-Chloroethylvinylether	NA	NA	NA	NA	NA
Chloroform ⁱ	NA	NA	100	NA	NA
Chloromethane	NA	NA	NA	NA	NA
Dibromochloromethane ^j	NA	NA	100	NA	NA
1,2-Dichlorobenzene	NA	NA	600	10 ^g	600
1,3-Dichlorobenzene	NA	NA	600	NA	600
1,4-Dichlorobenzene	5	NA	75	5 ^g	75
1,1-Dichloroethane	5	NA	NA	NA	NA
1,2-Dichloroethane	0.5	NA	5	NA	0.0
1,1-Dichloroethene	6	NA	7	NA	7
1,2-Dichloroethene ^k	6	NA	70	NA	70
1,2-Dichloropropane	5	NA	5	NA	0.0
1,3-Dichloropropene	0.5	NA	NA	NA	NA
Ethylbenzene	680	NA	700	30 ^g	700
Ethylene dibromide	0.02	NA	0.05	NA	0.0
Methylene chloride	NA	NA	5	NA	0.0
Oil & Grease	NA	NA	NA	NA	NA
Pentachlorophenol	NA	NA	1	NA	NA
TPH as Diesel	NA	NA	NA	NA	NA
TPH as Gasoline	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	1	NA	NA	NA	NA
Tetrachloroethene	5	NA	5	NA	0.0
Toluene	NA	NA	1,000	40 ^g	1,000
1,2,4-Trichlorobenzene	NA	NA	70	NA	70

**Table F1. Federal and State Groundwater Standards
Volume II - Remedial Investigation, Basewide RI/FS
Ford Ord, California**

Chemical	CA MCL ^c (primary) (µg/l)	CA MCL ^c (secondary) (µg/l)	FED MCL ^d (primary) (µg/l)	FED MCL ^d (secondary) (µg/l)	FED MCLG ^d (primary) (µg/l)
1,1,1-Trichloroethane	200	NA	200	NA	200
1,1,2-Trichloroethane	32	NA	5	NA	3
Trichloroethene	5	NA	5	NA	0.0
Trichlorofluoromethane	150	NA	NA	NA	NA
Vinyl chloride	0.5	NA	2	NA	0.0
Xylenes (total)	1,750	NA	10,000	20 ^e	10,000

CA MCL California Maximum Contaminant Level.

FED MCL Federal Maximum Contaminant Level.

FED MCLG Federal Maximum Contaminant Level Goal.

µg/l Micrograms per liter.

NA Not available.

a Cal/EPA, 1991.

b Marshack, 1991.

c Title 22 California code of Regulations, Sections 64435, 64444.5, and 64473, June 21, 1991.

d EPA, 1992g.

e For copper and lead, a treatment techniques triggered at an action level of 1,300 µg/l for copper and 15 µg/l for lead became effective 1/93 in lieu of an MCL.

f The CA MCL for fluoride is determined by the annual average of the maximum daily air temperature. For temperatures ≤53.7°F, MCL = 2,400 µg/l; for 53.8-58.3°F, MCL = 2,200 µg/l; for 58.4-63.8°F, MCL = 2,000 µg/l; for 63.9-70.6°F, MCL = 1,800 µg/l; for 70.7-79.2°F, MCL = 1,600 µg/l; for 79.3-90.5°F, MCL = 1,400 µg/l

g This is a proposed secondary federal MCL.

h The CA MCL is for nitrate as NO₃.

i Cal/EPA, 1989.

j Federal MCLs and MCLGs are for trihalomethanes (i.e., bromodichloromethane, bromoform, chloroform, and dichlorobromomethane).

k Standards are based on cis-1,2-dichloroethene.

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Table 9a. Summary of Inorganic Analytical Results for Soil Samples, Study Area 1 - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Test Method Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value	Basewide Background Minimum Detected Value	Basewide Background Maximum Detected Value
METALS BY ICP										
Antimony	30	11	10	9	30	mg/kg	9.30	3360.00	NA	NA
Chromium	30	30	0	0	30	mg/kg	7.00	53.80	3.3	46.1
Copper	15	15	0	0	15	mg/kg	5.50	19900.00	2.6	29.1
Iron	30	30	0	0	30	mg/kg	3310.00	31200.00	NA	NA
Lead	30	18	12	0	30	mg/kg	12.70	32600.00	2.1	51.8
Zinc	30	29	1	0	30	mg/kg	10.80	2160.00	4.4	105
EPA-282.2										
Tin	30	8	22	0	30	mg/kg	1.50	67.40	NA	NA
EPA-7211										
Copper	15	15	0	0	15	mg/kg	2.20	12.30	NA	NA
EPA-7196										
Chromium VI	32	0	30	2	32					
EPA-9045										
pH	30	30	0	0	30	ph	5.80	8.30	5.7	10
EPA-9081										
Cation Exchange Capacity as Na	30	30	0	0	30	meq/100g	4.60	17.60	NA	NA

ICP Inductively coupled plasma.
mg/kg Milligrams per kilogram.
meq/100g Milliequivalents per 100 grams.
NA Not Available
Note: Detailed analytical results presented in Appendix B.

Table 9b. Summary of Inorganic Analytical Results for Soil Samples, Study Area 2 - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Test Method Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value	Basewide Background Minimum Detected Value	Basewide Background Maximum Detected Value
METALS BY ICP										
Antimony	30	7	23	0	30	mg/kg	10.50	970.00	NA	NA
Chromium	30	30	0	0	30	mg/kg	6.20	24.90	3.3	46.1
Copper	15	15	0	0	15	mg/kg	8.70	4180.00	2.6	29.1
Iron	30	30	0	0	30	mg/kg	3010.00	30400.00	NA	NA
Lead	30	21	9	0	30	mg/kg	11.00	46300.00	2.1	51.8
Zinc	30	30	0	0	30	mg/kg	6.30	531.00	4.4	105
Tin	1	1	0	0	1	mg/kg	21.70	21.70	NA	NA
EPA-282.2										
Tin	29	5	24	0	29	mg/kg	1.00	8.90	NA	NA
EPA-7211										
Copper	15	15	0	0	15	mg/kg	1.30	4.40	NA	NA
EPA-7196										
Chromium VI	31	0	28	3	31					
EPA-9045										
pH	30	30	0	0	30	ph	5.30	7.80	5.7	10
EPA-9081										
Cation Exchange Capacity as Na	30	30	0	0	30	meq/100g	3.40	40.30	NA	NA

ICP Inductively coupled plasma.
mg/kg Milligrams per kilogram.
meq/100g Milliequivalents per 100 grams.
NA Not Available

Note: Detailed analytical results presented in Appendix B.

Table 9c. Summary of Inorganic Analytical Results for Soil Samples, Control Area - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Test Method Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value	Basewide Background Minimum Detected Value	Basewide Background Maximum Detected Value
METALS BY ICP										
Antimony	9	0	9	0	9				NA	NA
Chromium	9	9	0	0	9	mg/kg	3.20	17.90	3.3	46.1
Iron	9	9	0	0	9	mg/kg	1810.00	8560.00	NA	NA
Lead	9	1	8	0	9	mg/kg	14.20	14.20	2.1	51.8
Zinc	9	7	2	0	9	mg/kg	7.30	12.50	4.4	105
EPA-282.2										
Tin	9	0	9	0	9					
EPA-7211										
Copper	9	9	0	0	9	mg/kg	0.47	2.00	NA	NA
EPA-7196										
Chromium VI	9	0	9	0	9					
A-9045										
pH	9	9	0	0	9	ph	5.10	7.70	5.7	10
EPA-9081										
Cation Exchange Capacity as Na	9	9	0	0	9	meq/100g	2.00	8.70	NA	NA

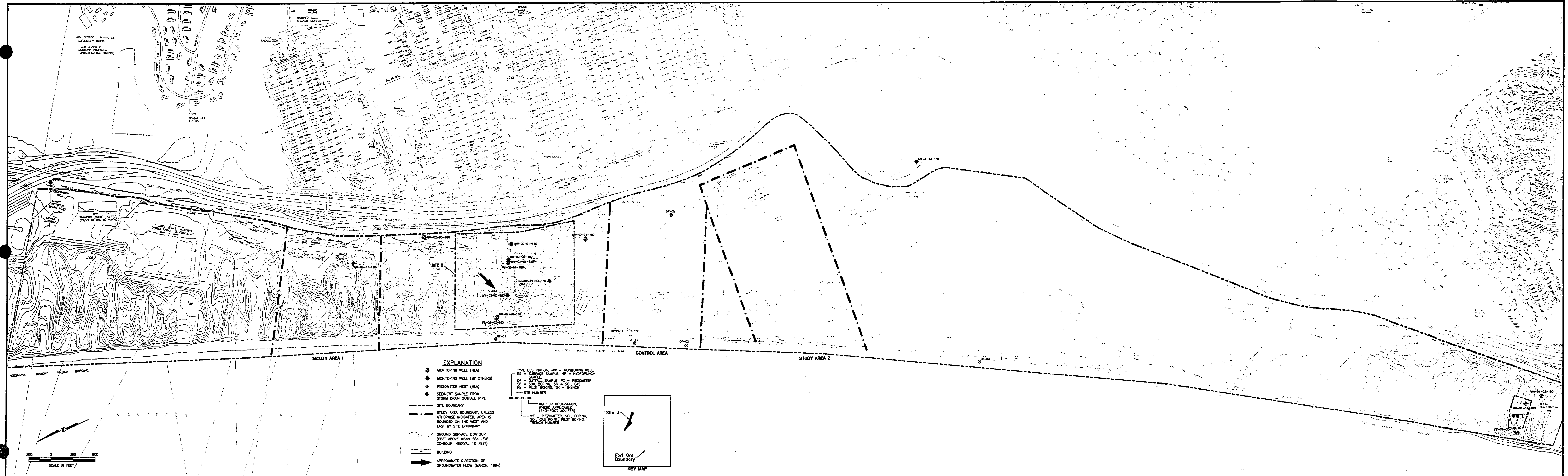
ICP Inductively coupled plasma.
mg/kg Milligrams per kilogram.
meq/100g Milliequivalents per 100 grams.
NA Not Available

Note: Detailed analytical results presented in Appendix B.

Table 10. Summary of Organic Analytical Results for Soil Samples - Site 3
Volume II - Remedial Investigation, Basewide RI/FS
Fort Ord, California

Test Method Analyte	Number of Samples Analyzed	Number of Samples With Detected Analyte	Number of Samples With Nondetected Analyte	Number of Samples With Results Rejected	Totals	Units	Minimum Detected Value	Maximum Detected Value	Basewide Background Minimum Detected Value	Basewide Background Maximum Detected Value
EPA-9060 Total Organic Carbon	69	69	0	0	69	mg/kg	229.00	14800.00	861.00	35,600.00

mg/kg Milligrams per kilogram
NOTE: Detailed analytical results presented in Appendix B.



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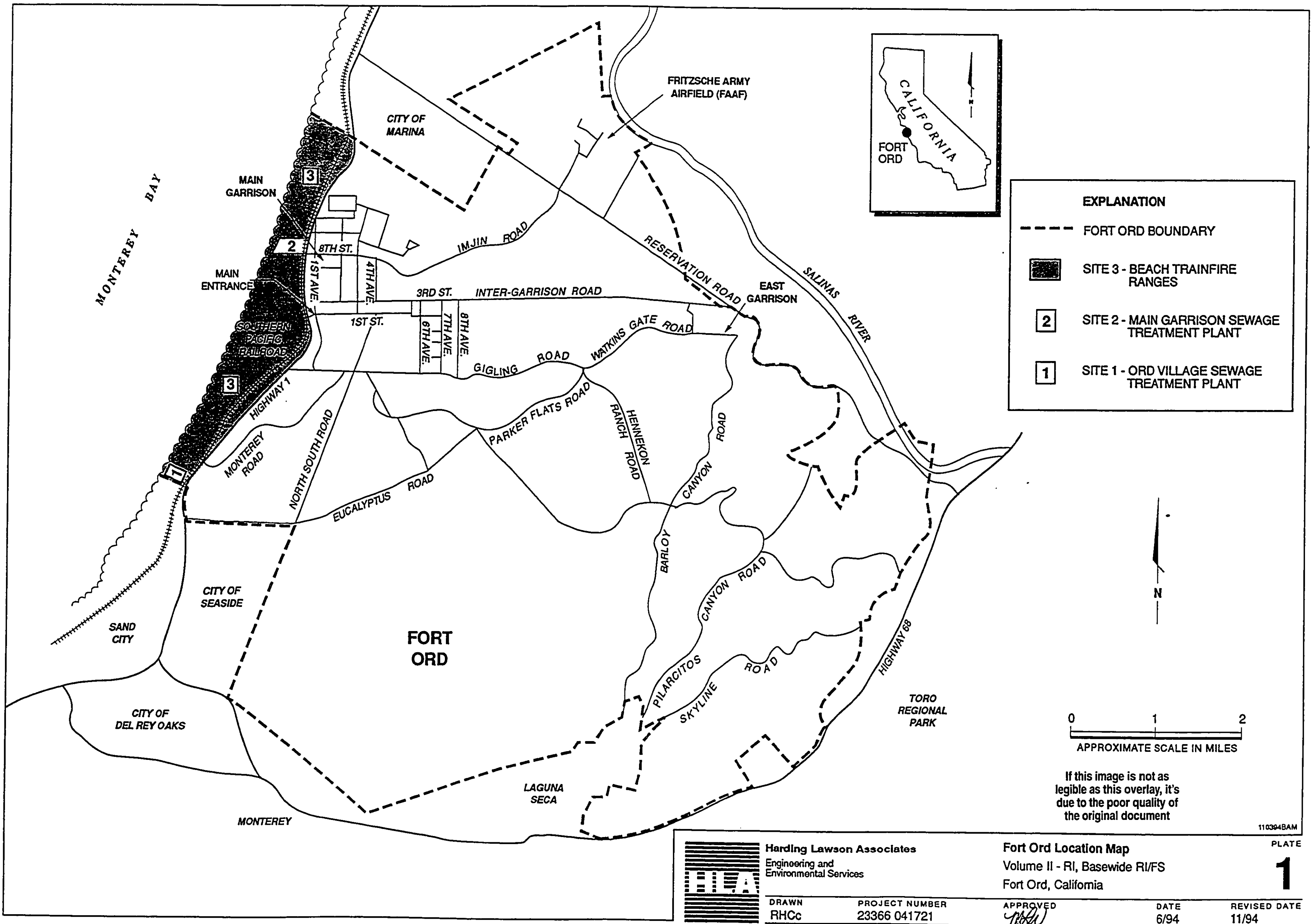
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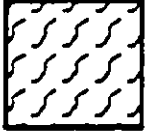
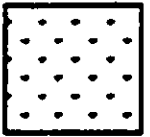
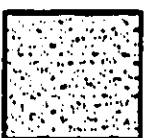
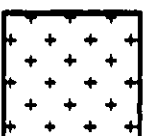
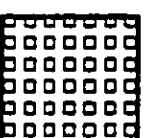

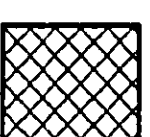
Fort Ord Location Map
Volume II - RI, Basewide RI/FS
Fort Ord, California

PLATE

1

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EXPLANATION

-  MONITORING WELL (HLA)
-  TEST PIT LOCATION
-  BULLET WEIGHT PERCENT CONFIRMATION SAMPLING LOCATION
-  FULLY DEVELOPED/NOT SURVEYED
-  UPLAND RUDERAL
-  LANDSCAPED
-  AREA OF ACTIVE DUNE
-  VEGETATIVELY STABILIZED DUNE
-  CENTRAL COASTAL SCRUB
-  BEACH
-  DRY IMPOUNDMENTS

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2	12/94	DRAFT FINAL	23366596	23366 087711	<i>[Signature]</i>	11-18-99	PH

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Volume III - Site 3
Basewide RI/FS
Fort Ord, California


Plant Communities
Control Area - Site 3


PLATE:
3


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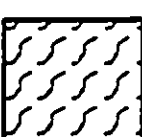
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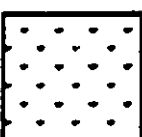
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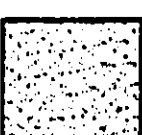
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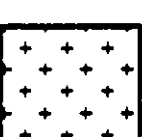
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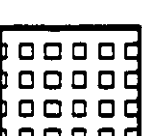
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FULLY DEVELOPED/NOT SURVEYED
- 

UPLAND RUDERAL
- 

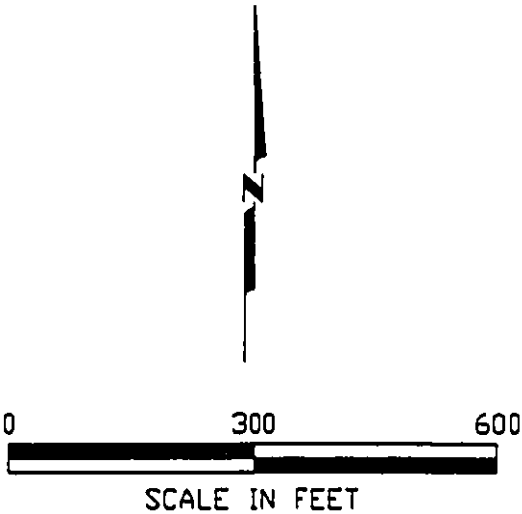
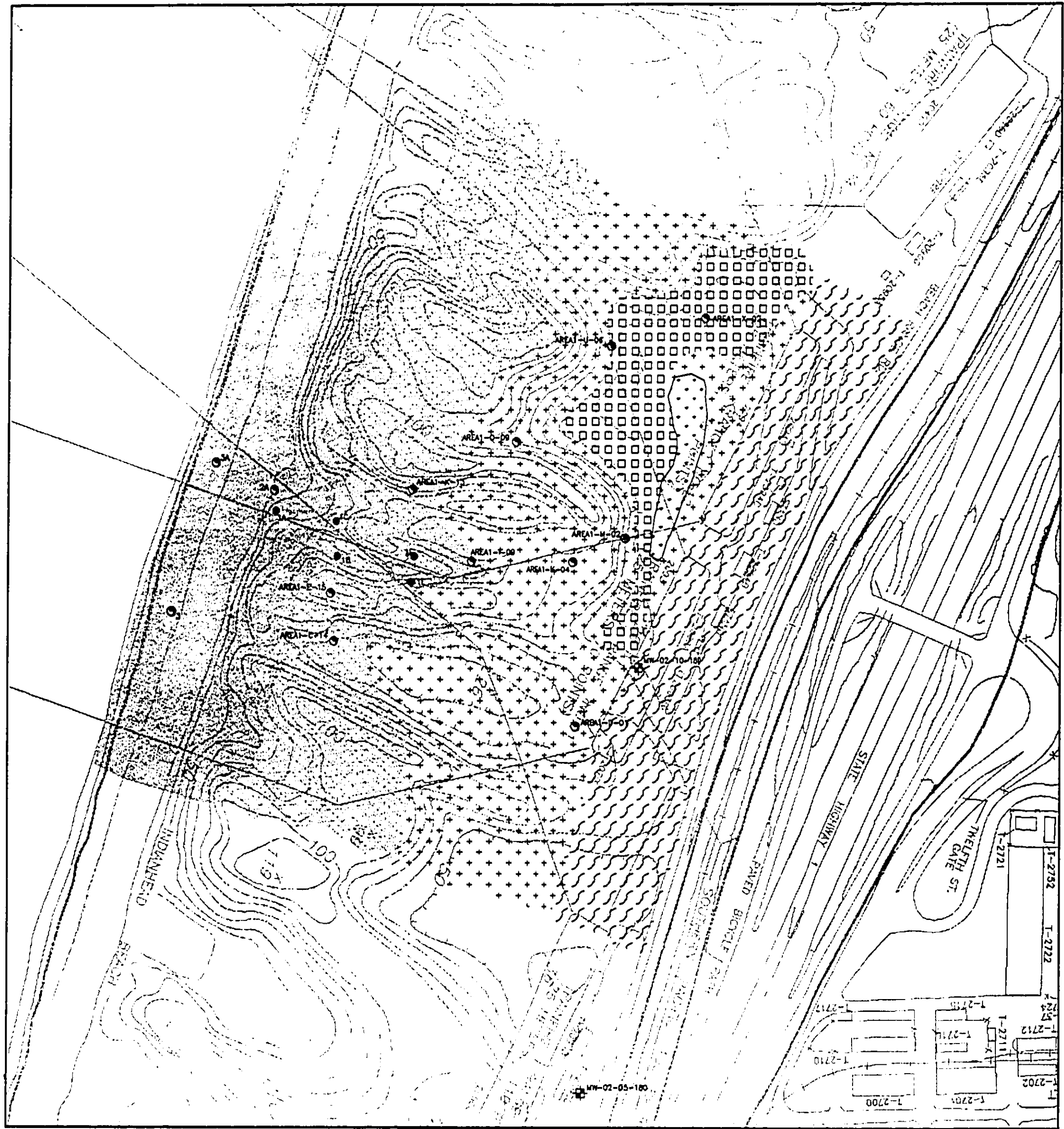
LANDSCAPED
- 

AREA OF ACTIVE DUNE
- 

VEGETATIVELY STABILIZED DUNE
- 

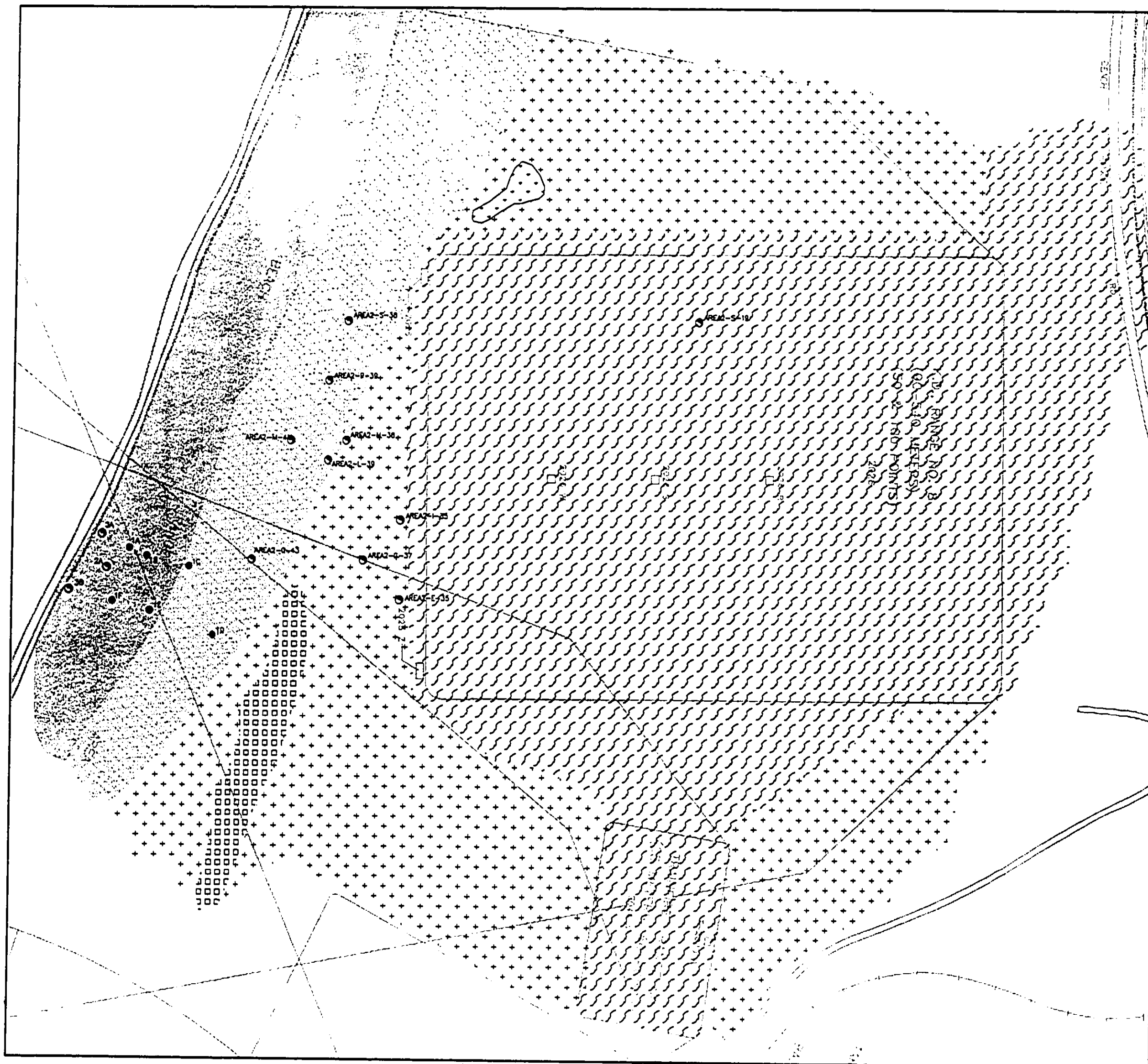
CENTRAL COASTAL SCRUB
- 

BEACH



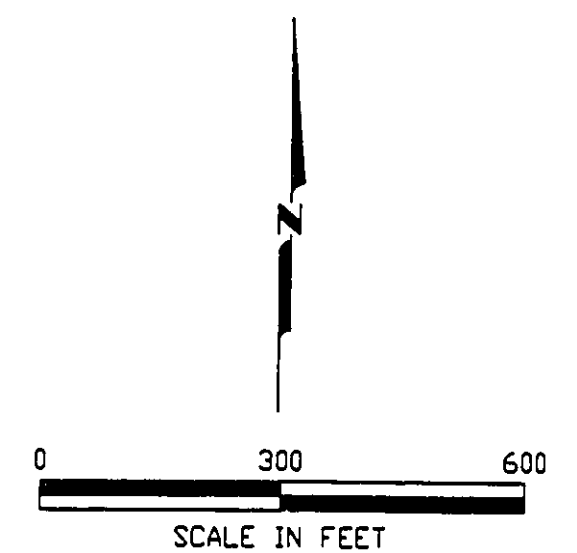
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NO.	DATE	REVISIONS	H/A FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY	Harding Lawson Associates Engineering and Environmental Services	Volume III - Site 3 Basewide RI/FS Fort Ord, California	Plant Communities Area 1 - Site 3	PLATE: 4
1	7/12/94	DRAFT	23366285	23366 041714			AED				
2	12/94	DRAFT FINAL	23366597	23366 087711		11-18-99	PH				



EXPLANATION

- AREA2-M-41 TEST PIT LOCATION
- 1A BULLET WEIGHT PERCENT CONFIRMATION SAMPLING LOCATION
- FULLY DEVELOPED/NOT SURVEYED
- ▨ UPLAND RUDERAL
- ▤ LANDSCAPED
- ▧ AREA OF ACTIVE DUNE
- ▩ VEGETATIVELY STABILIZED DUNE
- CENTRAL COASTAL SCRUB
- BEACH



If this image is not as legible as this overlay, it's due to the poor quality of the original document

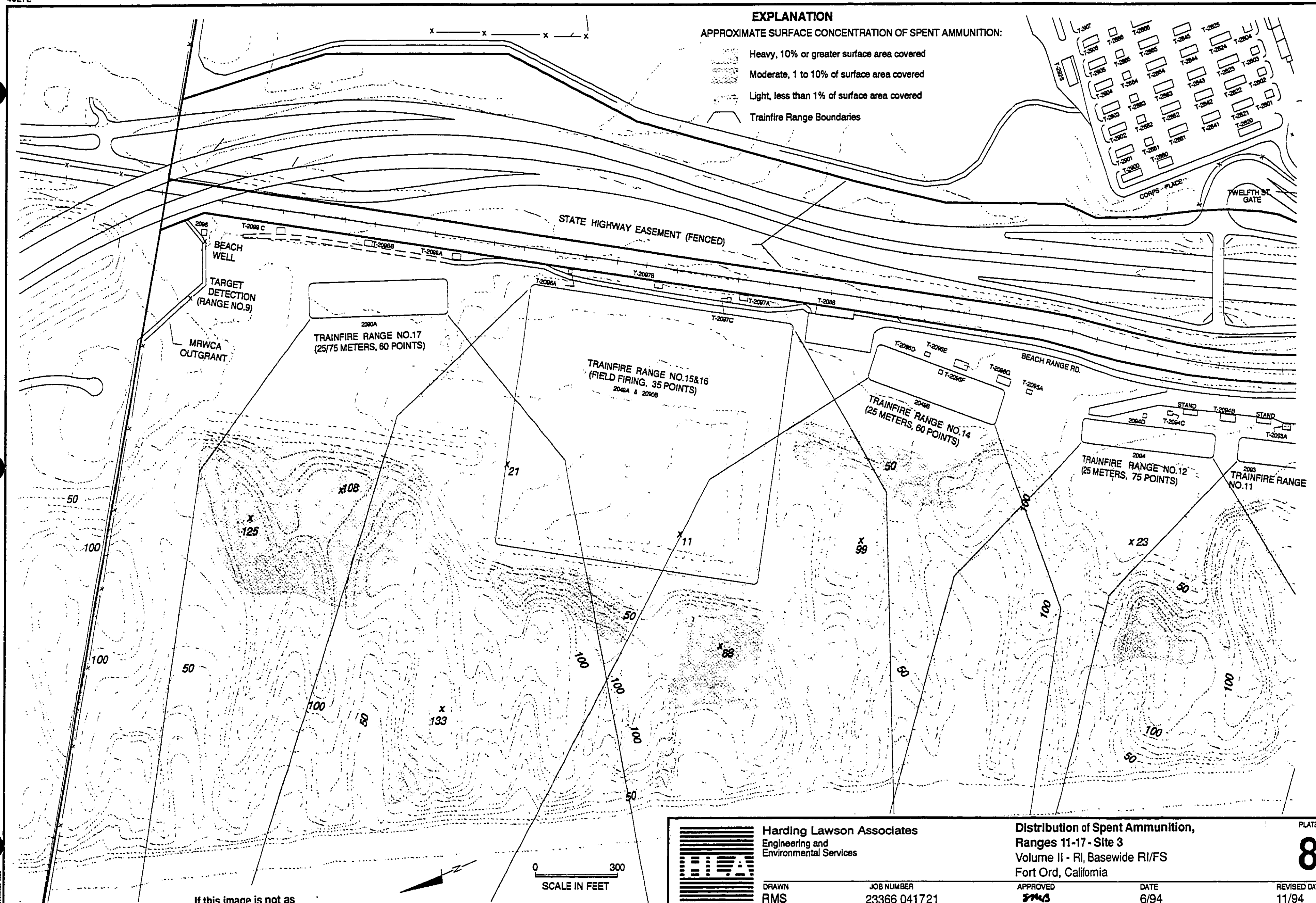
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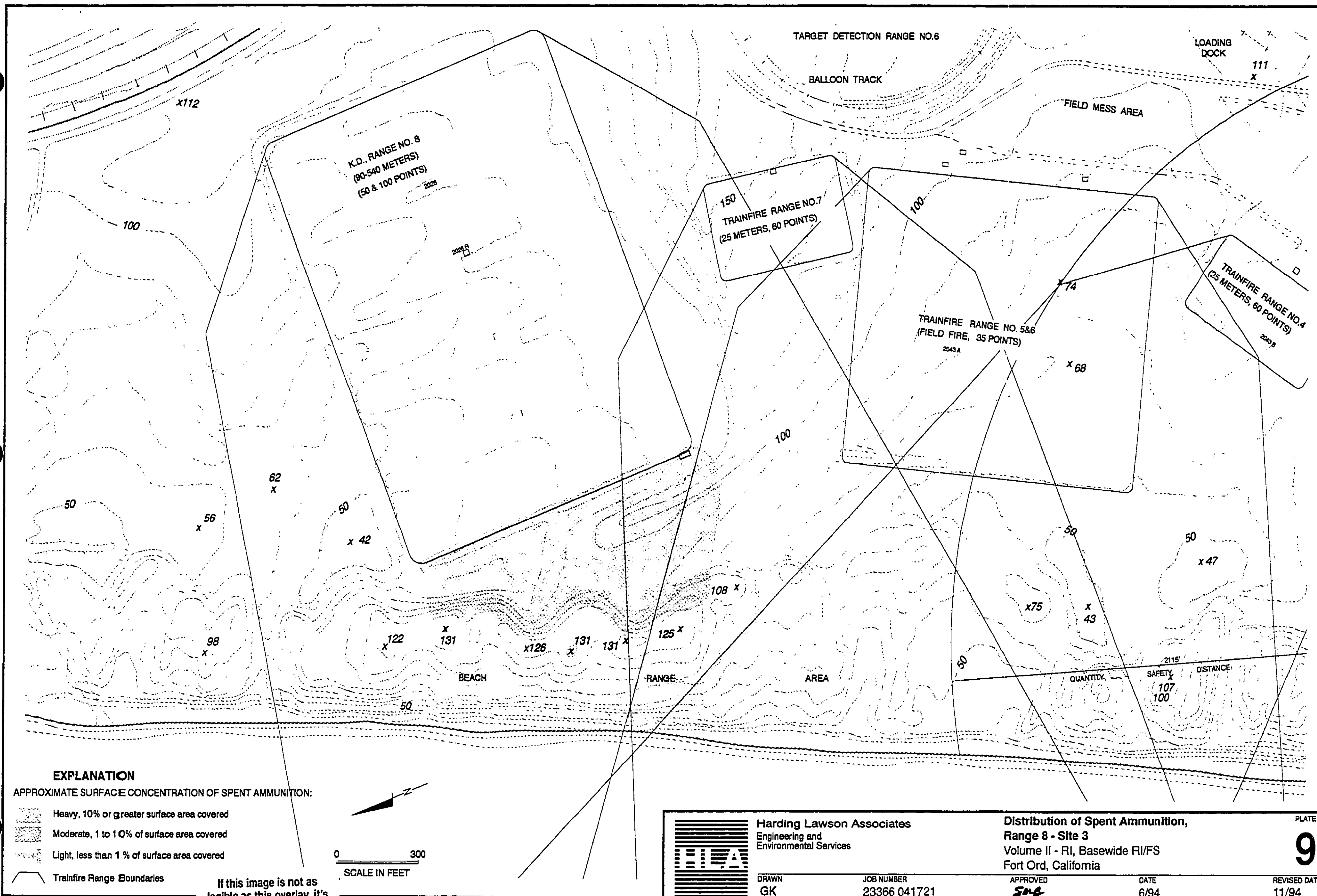
NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY	Harding Lawson Associates	Volume III - Site 3	Plant Communities	PLATE:
1	7/08/94	DRAFT	23366286	23366 041714				Engineering and Environmental Services	Basewide RI/FS	Area 2 - Site 3	5
2	12/94	DRAFT FINAL	23366598	23366 087711	PH	11/18/94	AED		Fort Ord, California		
							PH				

Page # 67 (2 PGS.)

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Document # BW-1283 I



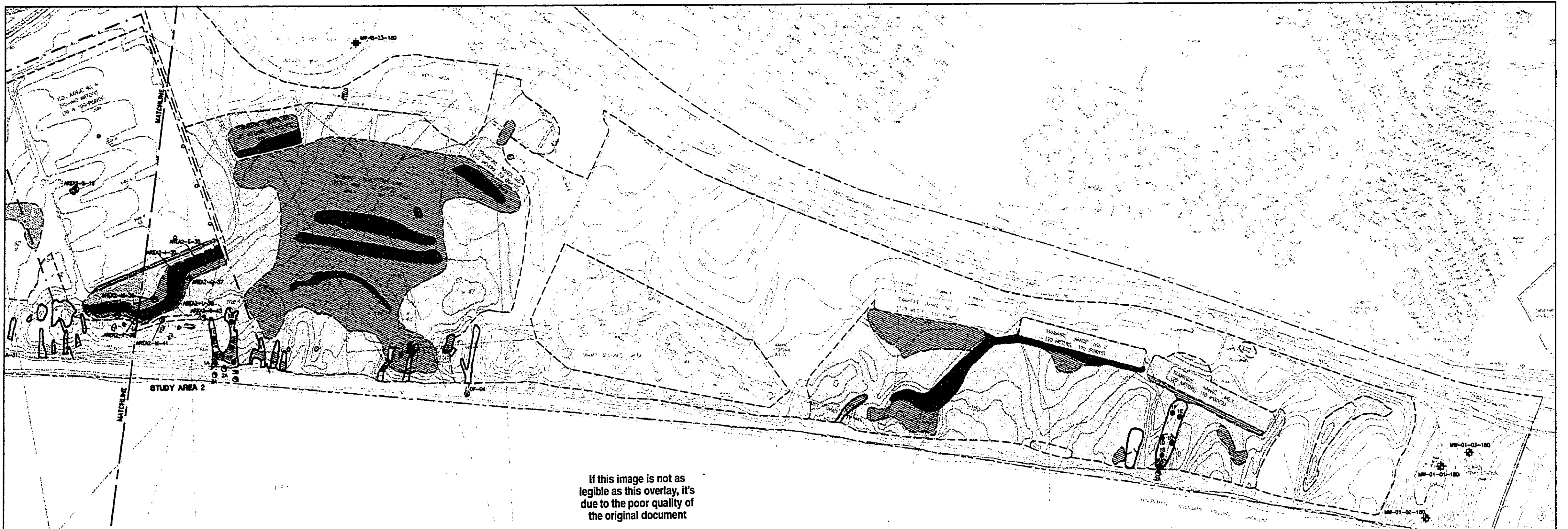
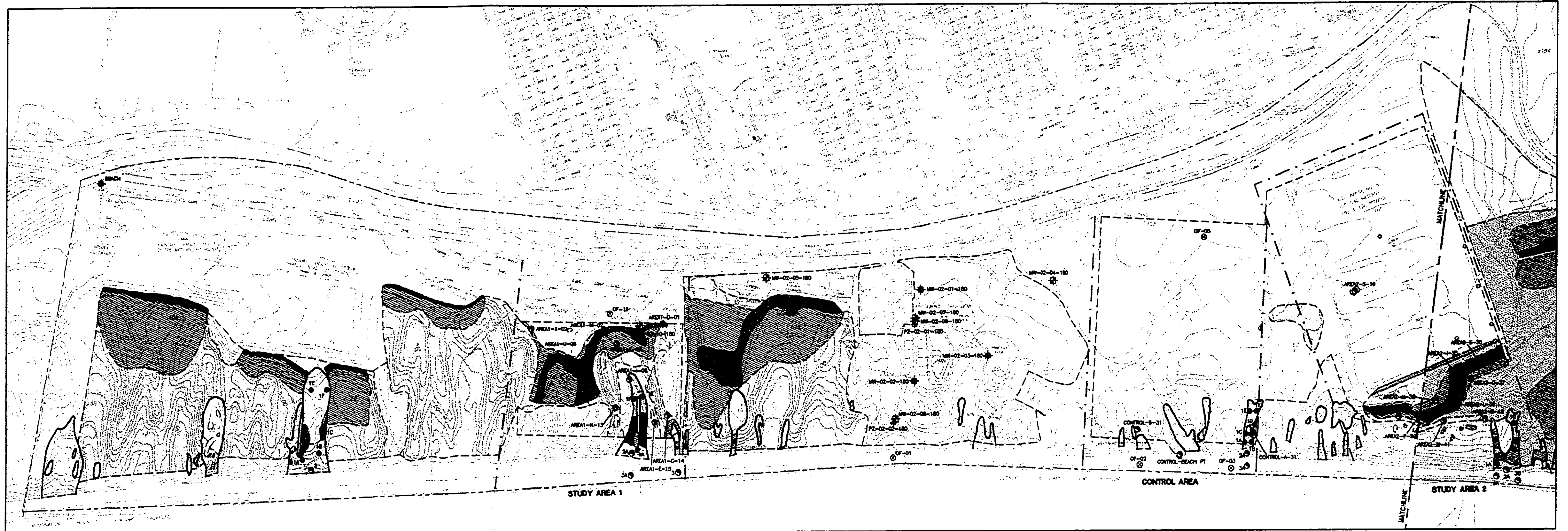


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Page # 69 (5 pgs.)

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Document # BW-1283 I



APPROXIMATE SURFACE CONCENTRATION OF SPENT AMMUNITION

	HEAVY, 10% OR GREATER SURFACE AREA COVERED		LIGHT, LESS THAN 1% OF SURFACE AREA COVERED
	MODERATE, 1 TO 10% OF SURFACE AREA COVERED		NO SPENT AMMUNITION PRESENT AT SURFACE

SCALE IN FEET
300 0 300 600

EXPLANATION

● HAND-DOUG TEST PIT	⊕ PIEZOMETER NEST (H/A)
● CONFIRMATION SAMPLE	● SEDIMENT SAMPLE FROM STORM DRAIN OUTFALL PIPE
⊕ MONITORING WELL (H/A)	--- SITE BOUNDARY
⊕ MONITORING WELL (BY OTHERS)	--- STUDY AREA BOUNDARY

160 GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)

160 BUILDING

▲ DUNE BLOWOUT LOCATION WITH SURFACE CONCENTRATION OF SPENT AMMUNITION

TYPE DESIGNATION: MW = MONITORING WELL, SS = SURFACE SAMPLE, HP = HYDRO-PUNCH SAMPLE, OF = OUTFALL SAMPLE, PZ = PIEZOMETER, SB = SOIL BORING, SG = SOIL GAS, PB = PILOT BORING, TR = TRENCH

SITE NUMBER

MW-01-01-180

--- AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)

WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER

NO.	DATE	REVISIONS	H/A FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	8/94	DRAFT	23366114	23366 02541			AED
2	12/94	DRAFT FINAL	23366114	23366 02641		11/18/94	AED

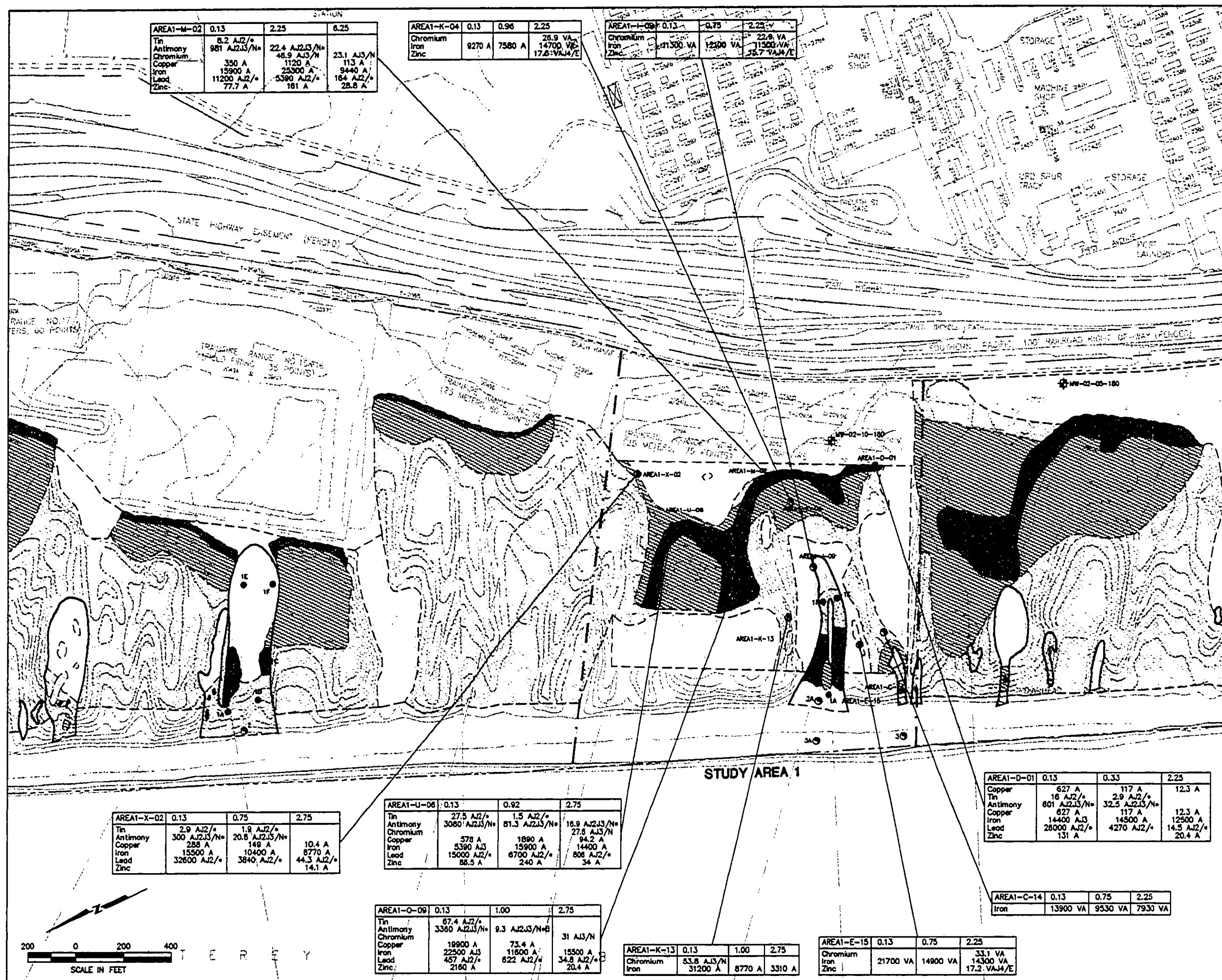
Harding Lawson Associates

Engineering and Environmental Services

Volume II - Remedial Investigation
Basewide RI/FS
Fort Ord, California

Distribution of Spent Ammunition - Site 3

PLATE:
11



- ### EXPLANATION
- HAND-DUG TEST PIT
 - CONFIRMATION SAMPLE
 - ⊕ MONITORING WELL (HLA)
 - ⊕ MONITORING WELL (BY OTHERS)
 - SITE BOUNDARY
 - STUDY AREA BOUNDARY
 - CONTACT BETWEEN AREAS OF DIFFERING SURFACE CONCENTRATIONS OF SPENT AMMUNITION
 - ⌒ BLOWOUT
 - 160' GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)
 - 1480' BUILDING

POSTING OF CHEMICALS

SAMPLE LOCATION	
SAMPLE DEPTH IN FEET BELOW GROUND SURFACE	
SS-12-03 (0.5)	
Lead	26.2 A
Zinc	18.3 NJ

PROJECT AND LABORATORY QUALIFIERS: QUALIFIERS ARE DEFINED IN TABLE 13.

CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)

ANALYTES INCLUDE ALL INORGANICS EXCEEDING MAXIMUM BACKGROUND CONCENTRATIONS AND DETECTED CONCENTRATIONS OF INORGANICS FOR WHICH BACKGROUND CONCENTRATIONS ARE NOT AVAILABLE

EXPLANATION OF STATION NAME

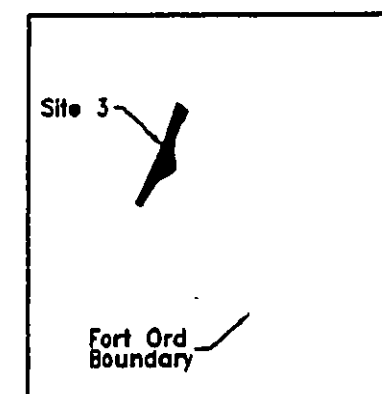
TYPE DESIGNATION: MW = MONITORING WELL, SS = SURFACE SAMPLE, HP = HYDROPUNCH SAMPLE, OF = OUTFALL SAMPLE, PZ = PIEZOMETER, SB = SOIL BORING, SG = SOIL GAS, PB = PILOT BORING, TR = TRENCH

SITE NUMBER: MW-02-01-180

AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)

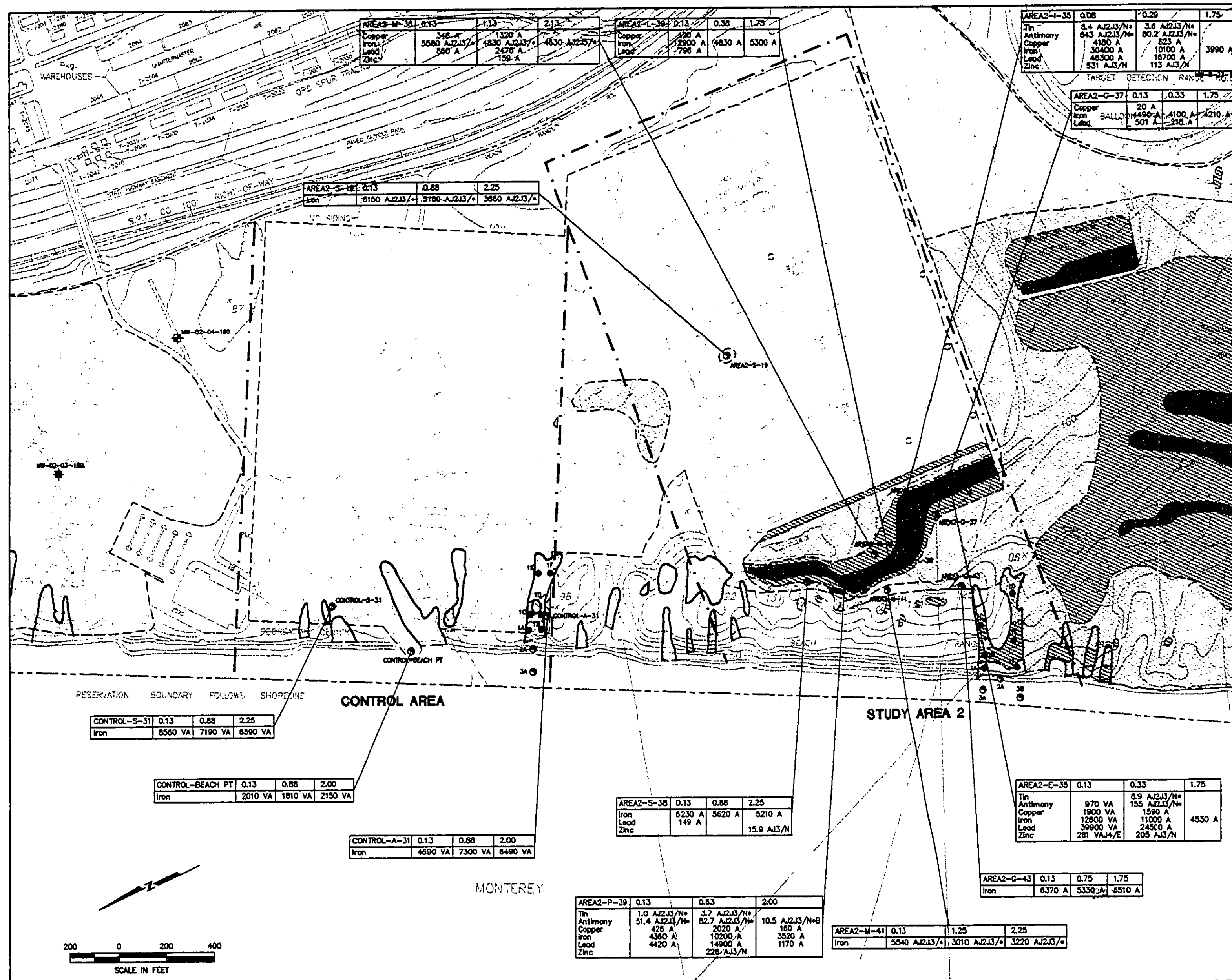
WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER

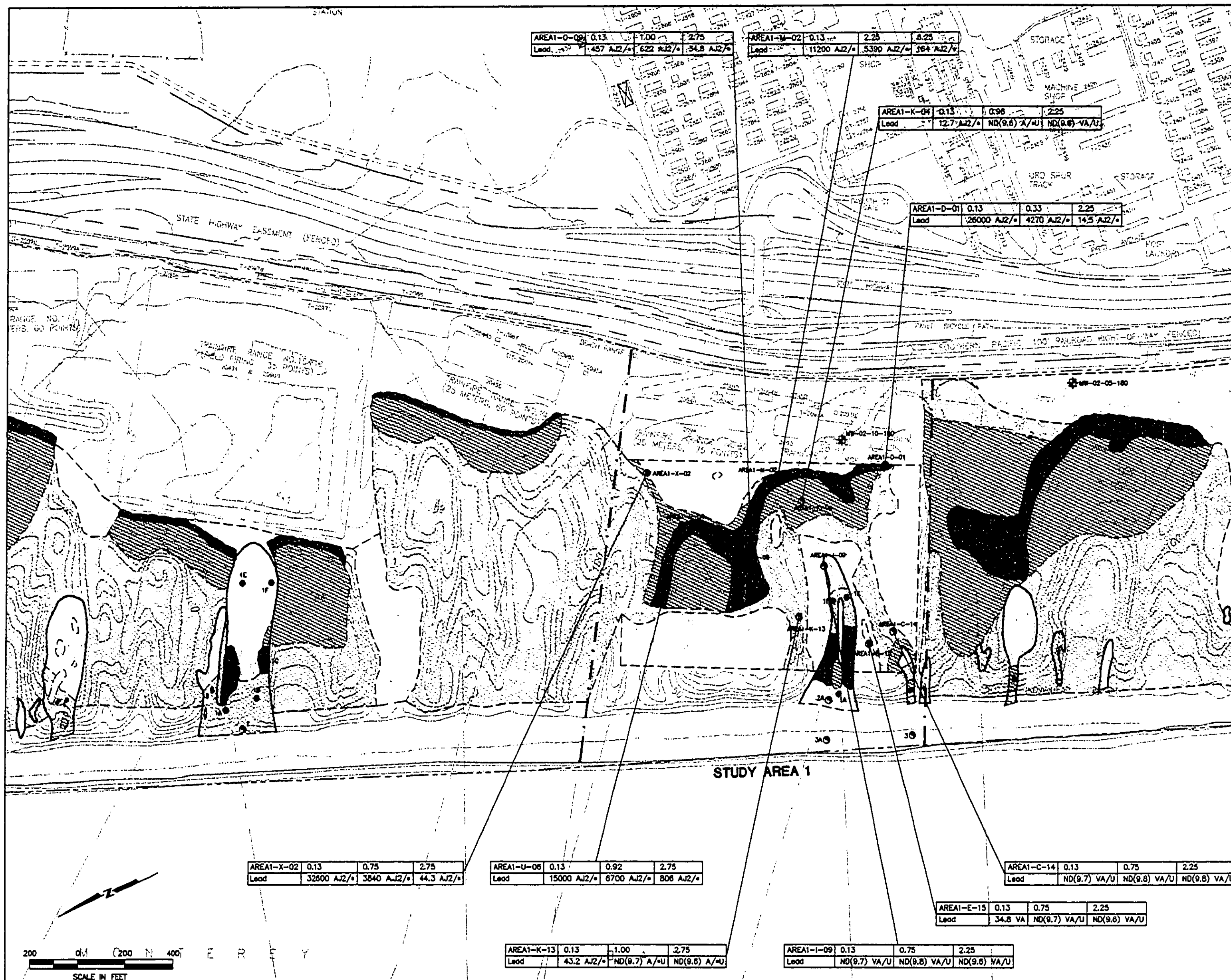
- HEAVY, 10% OR GREATER SURFACE AREA COVERED BY SPENT AMMUNITION
- ▨ MODERATE, 1 TO 10% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- ░ LIGHT, LESS THAN 1% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- NO SPENT AMMUNITION PRESENT AT SURFACE



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NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY	Harding Lawson Associates	Volume II - Remedial Investigation Basewide RI/FS Fort Ord, California	Distribution of Spent Ammunition and Metals Concentrations Study Area 1 - Site 3	PLATE:
1	8/94	DRAFT	23366173	23366 041711			AED	Engineering and Environmental Services			12
2	12/94	DRAFT FINAL	23366173	23366 041721			AED				





EXPLANATION

- HAND-DUG TEST PIT
- CONFIRMATION SAMPLE
- ⊕ MONITORING WELL (HLA)
- ⊕ MONITORING WELL (BY OTHERS)
- SITE BOUNDARY
- - - STUDY AREA BOUNDARY
- - - CONTACT BETWEEN AREAS OF DIFFERING SURFACE CONCENTRATIONS OF SPENT AMMUNITION
- ~ BLOWOUT
- 160' GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)
- 140' BUILDING

POSTING OF CHEMICALS

SAMPLE LOCATION	
SAMPLE DEPTH IN FEET BELOW GROUND SURFACE	
SS-12-03 (0.5)	
Lead	28.2 A
Zinc	18.3 NJ
PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLE 1.3.	
CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)	

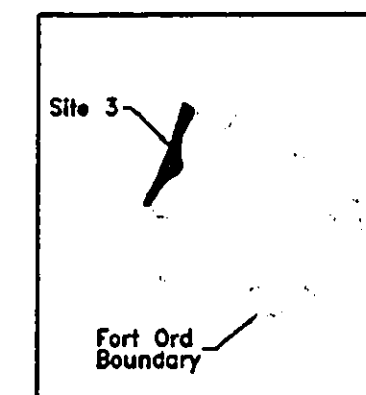
ANALYTES INCLUDES ALL INORGANICS EXCEEDING MAXIMUM BACKGROUND CONCENTRATIONS AND DETECTED CONCENTRATIONS OF INORGANICS FOR WHICH BACKGROUND CONCENTRATIONS ARE NOT AVAILABLE

EXPLANATION OF STATION NAME

TYPE DESIGNATION: MW = MONITORING WELL, SS = SURFACE SAMPLE, HP = HYDROPUNCH SAMPLE, OF = OUTFALL SAMPLE, PZ = PIEZOMETER, SB = SOIL BORING, SG = SOIL GAS, PB = PILOT BORING, TR = TRENCH

SITE NUMBER
MW-02-01-180
AQUICER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUICER)
WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER

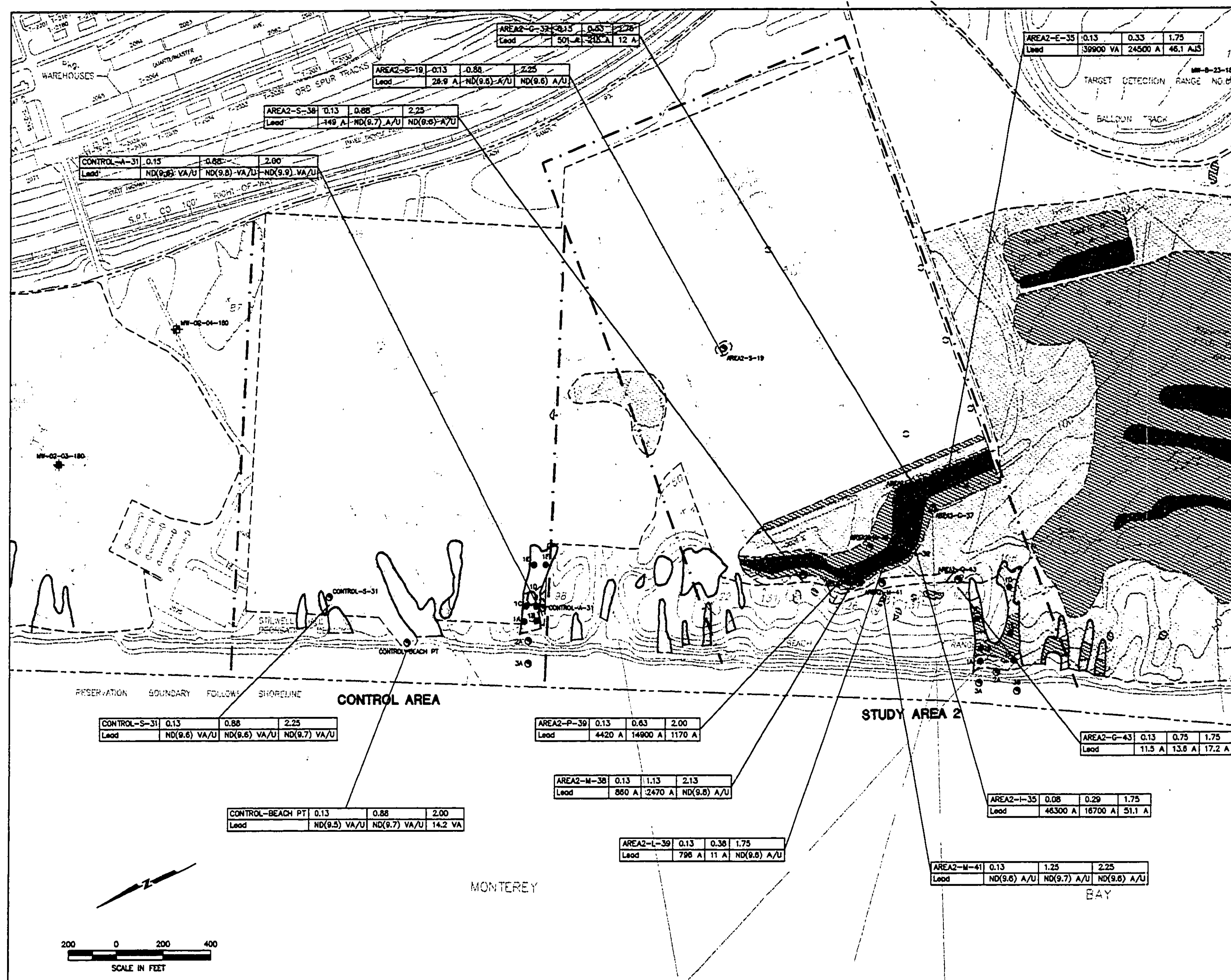
- HEAVY, 10% OR GREATER SURFACE AREA COVERED BY SPENT AMMUNITION
- ▨ MODERATE, 1 TO 10% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- LIGHT, LESS THAN 1% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- NO SPENT AMMUNITION PRESENT AT SURFACE



KEY MAP

If this image is not as legible as this overlay, it's due to the poor quality of the original document

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY	Harding Lawson Associates Engineering and Environmental Services	Volume II - Remedial Investigation Basewide RI/FS Fort Ord, California	Lead Concentrations Study Area 1 - Site 3	PLATE:
1	8/94	DRAFT	23366175	23366 041711			AED				14
2	12/94	DRAFT FINAL	23366175	23366 041721			AED				



EXPLANATION

- HAND-DUG TEST PIT
- CONFIRMATION SAMPLE
- ⊕ MONITORING WELL (HLA)
- ⊕ MONITORING WELL (BY OTHERS)
- SITE BOUNDARY
- - - STUDY AREA BOUNDARY
- - - CONTACT BETWEEN AREAS OF DIFFERING SURFACE CONCENTRATIONS OF SPENT AMMUNITION
- ⌒ BLOWOUT
- 160' GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)
- 1480' BUILDING

POSTING OF CHEMICALS

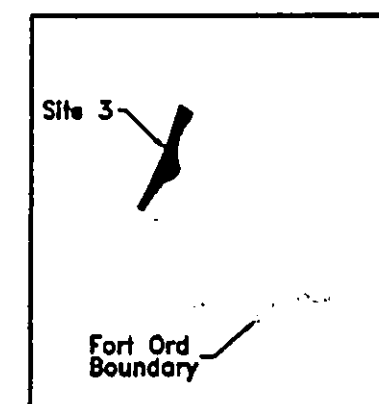
- SAMPLE LOCATION
- SAMPLE DEPTH IN FEET BELOW GROUND SURFACE
- SS-12-03 (0.5)
- Lead 26.2 A
- Zinc 16.3 NJ
- PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLE 1.3.
- CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)

ANALYTES INCLUDE ALL INORGANICS EXCEEDING MAXIMUM BACKGROUND CONCENTRATIONS AND DETECTED CONCENTRATIONS OF INORGANICS FOR WHICH BACKGROUND CONCENTRATIONS ARE NOT AVAILABLE

EXPLANATION OF STATION NAME

- TYPE DESIGNATION: MW = MONITORING WELL, SS = SURFACE SAMPLE, HP = HYDROPLUNCH SAMPLE, OF = OUTFALL SAMPLE, PZ = PIEZOMETER, SB = SOIL BORING, SC = SOIL GAS, PB = PILOT BORING, TR = TRENCH
- SITE NUMBER
- MW-02-01-180
- AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)
- WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER

- HEAVY, 10% OR GREATER SURFACE AREA COVERED BY SPENT AMMUNITION
- MODERATE, 1 TO 10% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- LIGHT, LESS THAN 1% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- NO SPENT AMMUNITION PRESENT AT SURFACE



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY	Harding Lawson Associates	Volume II - Remedial Investigation Basewide RI/FS Fort Ord, California	Lead Concentrations Control Area and Study Area 2 - Site 3	PLATE:
1	8/94	DRAFT	23366174	23366 041711			AED	Engineering and Environmental Services			15
2	12/94	DRAFT FINAL	23366174	23366 041721		11-18-94	AED				

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